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ABSTRACT

A prototype software program and accompanying user's manual were developed for teaching vocational English related to basic electricity/electronics to limited English proficient students. The software package was designed to be adaptable to other content areas. Preliminary activities included compilation of a list of learning objectives for and identification of vocational language related to basic electricity/electronics. The prototype computer-assisted instruction (CAI) vocational English-as-a-second-language program included 10 activities, 2 reading passages, and 2 cloze tests (pre and post). The lesson was programmed using Apple Pilot, and a user's manual with a guide for creating new CAI lessons was developed. The prototype was tested through external reviews and pilot testing. Following the eight-page narrative are appendixes that include a list of sources for the task analysis list, cross-referenced block of tasks, a task analysis list for basic electricity/electronics, various materials with vocational language related to basic electricity/electronics, a sample lesson outline, an evaluator's review of the prototype and manual, a student's review of the prototype, and a list of material and human resources. (YLB)

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Computer Assisted VESL Instruction for Vocational Education: Final Report FY-84

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Computer Assisted VESL Instruction for Vocational Education

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Research and Development Section

September, 1984

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Official Project Title: Computer Assisted VESL Instruction for Vocational Education

DAVTE Funding Agreement Number: R-31-14-C-0332-502

Project Director: Jeanne Lopez-Valadez

Funded Agency: Northwest Educational Cooperative

Location of Funded Agency: 500 South Dwyer Avenue, Arlington Heights, IL 60005

Time Period Covered: August 15, 1983 - September 10, 1984

Major Accomplishments of the Project:

1. Compiled and verified a list of learning objectives for basic electricity/electronics.
2. Identified and grouped by competencies vocational language related to basic electricity/electronics compiled from VESL materials, computer analysis of vocational texts and oral language sample from vocational instructors.
3. Developed prototype CAI VESL lesson for basic electricity/electronics with 10 activities, two reading passages and two cloze tests (pre and post).
4. Programmed lesson using Apple Pilot.
5. Developed user's manual with guide for creating new CAI lessons.
6. Evaluated prototype through external reviews (4) and pilot-testing at three vocational sites.
7. Revised and debugged prototype.

Potential Impact on Vocational Education:

Increase the ability of LEP and other special needs students to participate in vocational education by providing CAI resources to teach vocational ESL.

Products Delivered:

2 copies of a semi-annual progress report to DAVTE on January 31, 1984.
12 copies of final report to DAVTE on September 10, 1984.
11 copies of basic electronic prototype program and user's manual to DAVTE on September 10, 1984.

EXPENDITURE OF FUNDS

The following budget modifications were approved:

Contractual Services increased by 5%

1. Unexpended staff and consultant travel funds were redirected to consultant fees.

2. Telephone cost rose with the AT&T devestiture and the need for coordination via the phone rather than at meetings.

MAJOR ACCOMPLISHMENTS

Proposed Objective 1: DEVELOP BY JULY 30, 1984, A PROTOTYPE SOFTWARE PROGRAM AND ACCOMPANYING USER'S MANUAL FOR TEACHING VOCATIONAL ENGLISH RELATED TO BASIC ELECTRICITY/ELECTRONICS TO LEP STUDENTS.

1.0 By October 1, 1983, identified consultant staff - two vocational teachers, two ESL specialists and a computer programmer. On November 1, 1983, conducted orientation meeting to determine perimeter of materials to be developed. (See Appendix A for names and descriptions of consultants.)

1.1 By September 30, 1983, project coordinator compiled a list of learning objectives for teaching basic electricity/electronics.

- Conducted search of existing task analysis lists through the Illinois Vocational Curriculum Center.
- Contacted vocational programs for curriculum in electricity/electronics.
- Reviewed major texts in the field to identify common topics covered. (Appendix B)
- Cross-referenced blocks of tasks in five curricula and a text in electricity/electronics. (Appendix C)
- Send task analysis list with validation instrument to project's vocational consultants and three other vocational teachers. (Appendix D)

1.2 By November 15, 1983, project coordinator identified vocational language related to basic electricity/electronics. (See Appendix E).

- Contacted U.S. Department of Education, OBEMLA, and obtained copy of vocabulary frequency lists for electricity/electronics compiled through computer analysis (USDE contract 300-80-0810)
- Contacted vocational programs and obtained language resources from Arizona, New York and Massachussetts.
- Reviewed catalogs for electricity/electronics materials and ordered those suitable as resources.
- Identified schools in Illinois using text, Exploring Electricity and Electronics which was used in computer analysis.
- Conducted NEC library search for resource materials.
- Conducted an ERIC search to identify VESL materials, bilingual vocational resources and CAI resources.
- Reviewed Guide to Microcomputer Coursework for Bilingual Education to identify ESL software and language authoring programs.

1.3 By November 30, 1983, project coordinator, ESL and vocational consultants grouped language according to vocational task sequence.

- Vocational consultants generated lists of vocabulary by learning objective. (See Appendix E)
- Project coordinator interviewed vocational consultants to generate instructional language related to performing vocational tasks.
- ESL consultants subdivided language into technical and sub-technical vocabulary.

1.4 By December 1, 1983, project coordinator and ESL consultants developed language scope, sequence and format for the VESL prototype.

- Project coordinator and ESL consultants selected grammatical items to be taught and identified language functions to be addressed.
- Previewed sample ESL and vocational software.
- Produced a language lesson outline. (See Appendix F)

1.5 By January 20, 1984, ESL consultants developed sample worksheets for vocabulary and reading exercises for one task in electricity/electronics.

1.6 Vocational Consultant verified correct use of technical language in computer exercises.

1.7 By September 3, 1984, Computer Programmer programmed worksheets using Apple Pilot.

1.8 Computer programmer developed 5 copies of the CAI prototype to send to evaluators.

1.9 By September 3, 1984, Project Coordinator developed user's manual to accompany VESL prototype.

1.10 By September 5, 1984, Project Coordinator arranged for two evaluators to review prototype and manual.

1.11 By September 30, 1984, Project Coordinator coordinated pilot testing or the prototype in three vocational training sites offering basic electricity/electronics.

1.12 Project Coordinator and computer programmer revised the prototype based on pilot-test results and evaluation recommendations.

1.13 Project Coordinator submitted to DAVTE eleven copies of the computer program and its user's manual.

Proposed Objective 2: DEVELOP BY JULY 30, 1984, A MASTER SOFTWARE PROGRAM AND ACCOMPANY- ING USER'S MANUAL FOR TEACHING VOCATIONAL RELATED LANGUAGE WHICH CAN BE ADAPTABLE TO MULTIPLE VOCATIONAL TRANING AREAS.

2.1 Computer programmer developed master software program for use in various vocational areas based on prototype and Apple Pilot editing mode.

- Computer programmer met with ESL language consultant to identify potential language activities. (Nov. 1, Dec. 17, Jan. 18)

- Computer programmer previewed existing authoring programs.

- Computer programmer investigated interfacing computer to audio cassette or video cassette tape.

- Computer programmer investigated the use of graphics/animation in the use of each activity.

- Computer programmer changed to Apple Pilot authoring software and re-programmed all the VESL activities.

2.2 By September 10, 1984, Computer programmer and Project Coordinator developed a guide for creating VESL computer lessons as part of the manual for using the CAI prototype.

2.3 Sent manual and prototype to two evaluators who are designing VESL CAI to assess its adaptability to other vocational fields.

STAFF DEVELOPMENT

The project director attended the following meetings and conference to identify proposed or existing CAI and VESL resources and to disseminate information about the project.

October 13, 1983	"Teacher Friendly" ESL Computer Instruction Workshop, Arlington Heights, IL.
November 17-18, 1983	Ford Foundation Meeting for LEP vocational projects. San Francisco, CA
December 3-5, 1983	AVA Conference, Anaheim, CA

DISSEMINATION

Goal	Outcome	Activities Completed	Target Audience	Follow-up
Awareness of project outcomes	Information about project	Conducted presentations at workshops and meetings: AVA Conference - Anaheim, CA CA Adult Student Assessment Meeting TESOL Conference - Houston, TX	ESL & vocational educators	Monitored number of requests for additional information or product
		Communicated by phone and letter with 20 projects in IL, DC, CT, FL, AZ, CA, TX.	ESL, bilingual and vocational resource agencies and local programs	Will disseminate product abstract through a mailing (October, 1984)
	Project semi-annual and final reports	Submitted progress reports to DAVTE. (Jan. 31, 1984 and Sept. 10, 1984)	DAVTE and other recipients of reports	
	VESL prototype of basic electricity/ electronics & user's manual	Submitted 11 copies to DAVTE	DAVTE and other recipients of report	
Understand and implement project's outcomes	Draft of VESL prototype for basic electronics and accompanying user's manual	Field tested prototype at three vocational training sites: Olive Harvey College, IL Alamo Community College, TX L. A. Public Schools, CA	ESL and vocational educators	DAVTE should send questionnaire to ascertain the extent to which the product or its concepts are used/ will be used.
	Draft of VESL program and user's manual	Sent to four external evaluators: Dennis Terdy Dr. Joan Friedenberg Dennis Sayers Nancy Sieffer	ESL administrators ESL curriculum-specialist	Conduct six month follow-up to ascertain the extent to which the product or its concepts are/will be used.

PROBLEMS

The project encountered two problemmatic areas which affected the timely completion of its objectives.

1. Human Resources

   The project was continuosly undergoing personnel changes due to the fact that the consultants who were of a very high caliber, would leave the project for full time assignments elsewhere. There was a change of four ESL consultants, each providing very little notice time. This required orienting the new person to the project, to electronics, and to computer programming.

   The part-time nature (20% inkind) of the project coordinator made follow-up with the various consultants difficult. Moreover, some of the initial research activities could only be handled by the coordinator due to the need for phone access and secretarial assistance.

   Field testing of the material was to take place at the beginning of the Winter semester. With the delay in producing the materials, the project was forced to wait until the Fall for classes to again be offered.

2. Material Resources

   The vocational language of the lesson was to be based on previously conducted research at the federal level. Unfortunately accessing this material was very difficult. Once received, the material did not prove useful. Secondly, as the team became acquainted with existing CAI resources and more clearly defined the language needs for electronics/ electricity, the nature of the VESL coursework was continuosly being modified. In response, the computer programmer recommended amending the programming approach. Instead of developing a new language, he suggested utilizing an authoring system to make the material more accessible to the non programmer. Unfortunately this meant the project would not be able to use the assistnace of computer programming students.

   After extensive review of ESL software and authoring systems, Easy Pilot was selected. Programming was about half completed when major problems arose. This necessitated re-programming all the activities to Apple Pilot.

EVALUATION

A. Procedures

1. Using an instrument developed by the project director, five vocational instructors were asked to validate the identified learning objectives. (See Appendix D). The five responding instructors included :

   Richard Wierzbicki - Vocational Instructor, Institute Skills Ctr.
   Steve Thayer - Faculty Engineer, Furst McNess
   Thomas J. Klimiate - Vocational Instructor, Hubert Humphrey Vocational Resource Center.
   Jose A. Rosales - Vocational Instructor, Alamo Community College.

2. Using an instrument developed by the project director, two external evaluators were asked to review the electronics VESL prototype and manual. (See Appendix G). The evaluators included:

   Dennis Terdy - Director, Illinois Statewide ESL Service Center
   Joan Friedenberg - Co-director, Bilingual Vocational Instructor Florida International University.

3. Through pilot-testing and evaluation questionnaires, five electronics LEP students at Olive Harvey College were asked to assess the prototype. (See Appendix H).

4. Using an instrument developed by the project director, two external evaluators were asked to review the revised prototype and accompanying manual for using the lesson and developing other CAI lessons. (See Appendix G) These evaluators were:

   Nancy Sieffer - Director, LES Adult Vocational Program, Mesa Community College
   Dennis Sayers - Coordinator of the New England Bilingual Education Multifunctional Support Center, Hartford University

5. Through the use of questionnaires and observation, four sites will be asked to field-test the prototype and accompanying manual. The sites include:

   - St. Paul Technical Vocational Institute, MN
   - Hubert Humphrey Vocational Resource Center, MA
   - Los Angeles Public Schools, CA
   - Houston Community College, TX

B. Findings

1. Although there was not a unanimous agreement as to the order in which the vocational competencies should be taught or the length of time spent on each objective, the teaching order determined was:

1. Science of Electricity/Electronics
2. Sources of Electricity
3. Resistance
4. Current
5. Conductors and Insulators
6. Voltage
7. Power
8. Circuit Fundamentals

2. The results of the review by external evaluators provided valuable input for revising content, instructions, format, hints and scoring. Most of the suggestions made were implemented in the revision of the prototype. Further work is necessary to simplify the language level of the cloze pre-test and the true/false exercise. Overall, the physical characteristics (format, graphics, simplicity of user input) were rated very good. Additional graphics could enhance program. Ratings on the instructional style of the material were generally also very good. Students' ability to choose exercises and proceed at their own pace were seen as particularly helpful features. In terms of content, the evaluators did not feel qualified to judge its appropriateness because of their lack of familiarity with the field of electronics. However, the "hints" and help screen items were rated as very good with a few exceptions which have since been changed.

3. Both the evaluators comments and results of the pilot testing revealed that the prototype would require an intermediate language proficiency level for successful use. The exercises provided a range of difficulty depending on the student's linguistic and educational abilities. The instructions were seen as easy to understand. The students rarely needed teacher intervention to assist with directions. However, teacher support in the form of tutoring or extra hints were helpful. Students felt they learned both content and vocabulary.

   Except for one student, all felt the material was very interesting. Oral comments indicated the interest was largely due to the fact that it was CAI. All requested the future use of the computer learning lab. This is especially important as most had never operated a computer and were unfamiliar with this resource in their college.

STATEMENT OF IMPACT

- Students in basic electricity/electronics training programs using the VESL prototype will improve their English language skills thereby increasing their ability to participate in instruction and on the job.

- Programs using the VESL prototype for basic electricity/ electronics will have greater flexibility for individualizing and supplementing language instruction to special needs students thereby increasing student retention and success.

- Teachers and curriculum writers who use the vocational ESL software program and manual will have an increased ability to design VESL software specific to their local training and student needs.

Contribution

The VESL software package:

- Translated the results of research related to vocational language teaching into application for practitioners.

- Tested the applicability of CAI language instruction related to vocational training for LEP students.

- Provided a VESL lesson for basic electricity/electronics and a guide for developing other CAI lessons for VESL.

- LEP students participating in the pilot and field testing increased their understanding of the use of the Apple computer, electronics vocabulary and the random drift of electrons as evidenced by the evaluation forms.

APPENDIX A

Paid Participants

PROJECT STAFF

Name and Address: Jeanne Lopez-Valadez
1954 Brice Court
Palatine, IL 60067

Position or Job Title: Project Director

Name of Agency or Institution: Northwest Educational Cooperative

Background and Experience: Material Specialist and Consultant in bilingual and multicultural education. Language, literature and bilingual education teacher at secondary and college levels. Director of the Bilingual Vocational Education Center for eight years.

Name and Address: Tatiana Davidson
106 E. Burr Oak Drive
Arlington Heights, IL 60004

Position or Job Title: Executive Secretary

Name of Agency or Institution: Northwest Educational Cooperative

Background and Experience: Has worked for six years as secretary of the Bilingual Vocational Education Project, Illinois ESL/AE Service Center, and the Computer Assisted Instruction for VESL.

CONSULTANTS

Name and Address: Charles Faulkner
7739 N. Eastlake Terrace
Chicago, IL 60626

Position or Job Title: ESL Teacher

Name of Agency or Institution: Truman College, Chicago, IL

Background and Experience: Is the VESL training specialist at the Truman College Refugee Program. With over 4 years of experience teaching ESL and VESL, he also gives workshops in linguistic and behavioral skills. He is certified in NLP with advance training.

Name and Address: Kamla Koch
2625 W. Fitch
Chicago, IL 60645

Position or Job Title: ESL Teacher and Development Curriculum

Name of Agency or Institution: Chicago Urban Skill Institute, Chicago, IL

Background and Experience: Kamla Koch has worked with Indochinese refugees for 3 years as a teacher, curriculum writer and a coordinator. She has a M.A. in Linguistics from the University of Hawaii. Currently she is assisting in the writing of the Comprehensive Literacy Curriculum for the Chicago Urban Skill Institute.

Name and Address: Keith Mann
250 Osage Terrace
Buffalo Grove, IL 60090

Position or Job Title: Teacher

Name of Agency or Institution: Buffalo Grove High School, Buffalo Grove, IL

Background and Experience: Keith Mann has a B.S. in Computer Science and a MED in Computer Education and over 10 years of experience teaching high school computer science classes including curriculum development. He also has 6 years experience working with adult education retraining and business education consulting and 2 years managing a programming department for a large national company.

Name and Address: Richard Wierzbicki
19548 Pheasant Lane
Mokena, IL 50448

Position or Job Title: Vocational Teacher

Name of Agency or Institution: Industrial Skills Center, Chicago, IL

Background and Experience: Richard Wierzbicki has a B.S. in Industrial Education. He worked with Chicago Public Schools for more than 7 years. For three years he worked as an Engineer Associate for Western Electric and is presently teaching an electronic program.

Name and Address: Steve Thayer
249 West Maple Street
Stockton, IL 61085

Position or Job Title: Faculty Engineer

Name of Agency or Institution: Furst McNess

Background and Experience: Steve Thayer is a Faculty Engineer with Furst McNess; taught electronics at Stevenson Area Career Center and Highland Community College; developed competencies and learning packets in electronics/electricity.

Name and Address: Dr. Joan Friedenberg
13552 S.W. 108th Street, Circle N.
Miami, FL 33186

Position or Job Title: Co-director, Bilingual Vocational Instructor Training Program

Name of Agency or Institution: Florida International University

Background and Experience: Authored of numerous publications on bilingual vocational education, VESL, and computer assisted bilingual education. Bilingual teacher and bilingual vocational teacher trainer.

Name and Address: Patricia Menges
5544 Lyman
Downers Grove, IL 60516

Position or Job Title: Editor of Computer Products

Name of Agency or Institution: Mosaic Media, Inc.

Background and Experience: Formally she was a VESL Curriculum Developer for bilingual vocational program, a language consultant with the Netherland Refugee Council, and an ESL instructor.

Name and Address: Dennis Sayers

Position or Job Title: Coordinator of the New England Bilingual Education Multifunctional Support Center

Name of Agency or Institution: University of Hartford, West Hartford, CT

Background and Experience: Taught ESL in vocational programs. Developed bilingual vocational and VESL materials. Conducted bilingual vocational and ESL teacher training. Authored Computer-Assisted Language Learning in Bilingual Vocational Education.

Name and Address: Nancy Sieffer

Position or Job Title: Director, LES Adult Vocational Program

Name of Agency or Institution: Mesa Community College, Tempe, AZ

Background and Experience: Taught ESL. Served as instructor of a bilingual vocational teacher aide training program. Coordinated statewide conferences, developed manuals on language assessments, VESL instruction, and computer literacy for the LEP.

Name and Address: Dr. Joyce Malyn Smith

Position or Job Title: Manager, Occupational Instructional Design

Name of Agency or Institution: Humphrey Occupational Resource Center

Background and Experience: Not available at the time of this report.

Name and Address: Juan Alvarez

Position or Job Title:

Name of Agency or Institution: Olive-Harvey College

Background and Experience: Not available at the time of this report.

APPENDIX B

Major texts in the field of Electricity/Electronics

APPENDIX

SOURCES OF TASK ANALYSIS LIST

An analysis was made of the blocks of tasks in available curricula and a major text. The following were examined. Attached is a list of the blocks covered.

1. Industrial Arts Education Competency Catalogs for Electricity and Electronics, Virginia Department of Education, 1979.
2. Basic Electronics I & II, Oklahoma State Department of Vocational Education.
3. Electronics Technology, Suburban Hennepin County Area Vocational Technical Center, no date listed.
4. Electronics Occupations Curriculum Guide, Illinois Office of Education, 1975.
5. Basic Electronics I, L. Robertson, Mid-America Vocational Curriculum, Inc. 1980.
6. Electricity and Basic Electronics.

APPENDIX

ANALYSIS OF TOPICS IN TEXTBOOKS

The first, Electricity and Basic Electronics is the most comprehensive in subject matter and has the highest reading level.

The second text is Exploring Electricity/Electronics. It is less comprehensive and easier to read. This text was being used at Washburne Trade School in the Beginning Vending Machine Repair class.

The third text Electricity is the least comprehensive.

The summary of topics is below:

	Electricity & Basic Electronics, S. Matt, Goodheart-Willcox, 1977, 320 pages.	Exploring Electricity/ Electronics, Rollain & Kraus. Delmar Pubs., 1979, 194 pages.	Electricity, Miller & Francis, et al. McKnight, 1978, 74 pages.
Fundamentals	x	x	x
Sources of electricity	x	x	x
Conductors & Insulators	x	x	x
Resistors & Capacitors	x	-	x
Ohm's Law	x	x	x
Series Circuits	x	x	x
Parallel Circuits	x	x	x
Meters	x	x	x
Series Paralled Circuits	x	x	x
AC Voltage	x	x	x
Electromagnetic Induction	x	x	x
Motors	x	x	x
Inductive Reactance & Impedence	x	x	-
LCR Circuits	x	-	-
Filters	x	-	-
Dioders	x	x	x
Transistors	x	x	x
Integrated Circuits & other solid state devices	x	x	-
Power Supplies & the oscilloscope	x	x	-
Career Opportunities	x	-	x

APPENDIX C

Cross-referenced Blocks of Tasks

BEST COPY AVAILABLE

BLOCKS	Electronics Vols. I & II	Ind. Arts Ed. Comp Cat. for Elect. & Electronics	Basic Electronics I & II	Electronics Technology.	Electricity & Basic Electronics.	Electronics Curriculum Guide	Basic Electronics
1. Science of Electronics	I x	II	x	x	x	x	x
2. Source of Electricity	x		x	x	x		x
3. Circuits (power, current, voltage resistance and power)	x		x	x	x	x	x
4. Magnetism	x		x	x	x		x
5. Generators/Motors	x		x	x	x		x
6. AC Current			x	x	x		x
7. Inductance	x		x	x	x	x	x
8. Capacitance	x		x	x	x	x	x
9. RCL Networks	x		x	x	LRC		x
10. Instruments and Measurements	x	x		x	x	x	x
11. Vacuum Tubes & Semiconductors		x			x	x	
12. Power Supply (half & full wave, filter circuits)		x			x		
13. Electron Amplifiers		x					
14. Electronic Oscillators		x		x			
15. Radio Transmitters		x					
16. Radio Receivers		x					
17. Television		x					
18. Integrated Circuits		x					
19. Career Opportunities		x		x	x	x	x
20. Safety	x		x	x		x	x
21. Series Circuits			x	x	x	x	x
22. Parallel Circuits			x	x	x	x	x
23. Series-Parallel Circuits			x		x	x	x
24. Hand-tools				x		x	x
25. Integrated Circuits					x		
26. Transistors					x		
27. Cleaners						x	
28. Integrated Circuits/Solid State Devices					x		

APPENDIX D

Task Analysis List for Basic Electricity/Electronics

APPENDIX D

Name: _____

Title of Course: _____

Grade Level: 11-12 grade ____ adult voc. ____ C.C. ____ Other ____

Brief Description: _____

_____

_____

_____

Number the following topics from 1-8 in the order in which you teach them. Put N/A if you do not teach a particular topic.

____ Science of Electricity/Electronics-Basic Principles

____ Sources of Electricity

____ Circuits Fundamentals

____ Conductors and Insulators

____ Voltage

____ Current

____ Resistance

____ Power

Directions: Please respond to each item on the following pages by placing a check in the appropriate box. If a statement is unclear or needs modifying to fit your situation, write your suggestions in the comments column.

SCIENCE OF ELECTRICITY/ELECTRONICS - BASIC PRINCIPLES	Taught	Not taught	No. of class hrs on topic	Importance			Comments
				Little	Moderate	High	
Information							
1. Describe the random drift of electronics.							
2. Describe the law of electrical charges.							
3. Define, characterize, and explain the direction of current flow.							
Skills							
4. Create and observe the behavior of charges.							

SOURCES OF ELECTRICITY							
Information							
1. Identify five sources of electricity.							
2. Illustrate by example how the sources produce electricity.							
3. List the different types of primary cells and their application.							
4. Differentiate between a primary and secondary cell.							
5. Differentiate between a battery and a cell.							
Skills							
6. To use and test batteries.							
7. Generate electricity with magnetism.							
8. Generate electricity with pressure.							
9. Generate electricity with heat.							
10. Generate electricity with light.							

RESISTANCE	Taught	Not taught	No. of class hrs on topic	Importance			Comments
				Little	Moderate	High	
Information 1. List and describe the factors that determine the resistance of wire-length, size, temperature & material							
2. Identify the most commonly used resistors.							
3. Identify symbols for resistors and capacitors.							
4. Explain the color code.							
Skills 5. Read color-coded resistors.							
6. Measure the resistance of resistors with a VOM.							
7. Measure the circuit resistance with an ohmmeter.							

CIRCUITS FUNDAMENTALS							
Information 1. List the components parts of a simple circuit.							
2. List the factors that determine the resistance of wire.							
Skills 3. Construct a basic circuit from a schematic.							

POWER	Taught	Not taught	No. of class hrs on topic	Importance			Comments
				Little	Moderate	High	
Information							
1. Define and characterize power.							
2. State Watt's Law.							
Skills							
3. Determine power, given voltage and current.							
4. Determine current, given voltage and power.							
5. Determine voltage, given power and current.							
6. Measure power with a wattmeter.							

CURRENT							
Information							
1. Define current.							
2. Characterize current in terms of direction and magnitude.							
3. State procedures for using an ammeter.							
Skills							
4. Use an ammeter to measure current.							
5. Convert ampers to milliamps and microamps.							
6. Measure and compare current at two points of a circuit.							
7. Measure and compare in a circuit at two different voltage levels.							

CONDUCTORS AND INSULATORS	Taught	Not taught	No. of class hrs on topic	Importance			Comments
				Little	Moderate	High	
Information							
1. State the importance of conductors and insulators.							
2. Name soldering tools.							
3. Identify soldering procedures.							
4. State the characteristics of a good soldering							
Skills							
5. Strip and tie wire for soldered connections.							
6. Solder wires to various terminals.							
7. Splice wires together by soldering and crimping.							
8. Connect ends of printed wire.							
9. Measure wire size using the American Wire Gauge.							

VOLTAGE	Taught	Not taught	No. of class hrs on topic	Importance			Comments
				Little	Moderate	High	
Information 1. Define and characterize voltage.							
2. Identify common symbols and abbreviations.							
3. State Ohm's Law.							
4. Identify the parts of a voltmeter.							
5. State the procedures for using a voltmeter.							
Skills 6. Measure the voltage with a voltmeter.							
7. Determine voltage, given current and resistance.							
8. Determine current, given voltage and resistance.							
9. Determine resistance, given voltage and current.							

APPENDIX E

Vocational Language Related to Basic Electricity/Electronics

APPENDIX E

SCIENCE OF ELECTRICITY/ELECTRONICS-BASIC PRINCIPLES

DESCRIBE THE RANDOM DRIFT OF ELECTRONICS

energy	materials	orbit	copper	drift
ability	molecules	change	combination	free
potential	invisible	negative	experimental	external
motion	particular	positive	resist	removal
illustrate/show	atom	weights	repel	addition
controlled	smaller	identical	attract	produces
force	arrangement	contain	balanced	power
produces	miniature	structure	neutral	action
uncontrolled	nuclear	nucleus	distances	generate
structure	electron	characteristics	farther	invisible
matter	rotates	iron	smaller	force
together	field	increasing	decreasing	availability

DESCRIBE THE LAW OF ELECTRICAL CHARGES

like	repel	unlike	attract	basic
principles	electrons	accumulated	deficiency	excess
negative	positive	symbol	transfer	object
leave	point	produce	develop	charged
measure	potential	difference	illustrate	neutral
reference	less	positive	plus	minus
notion	body			

DEFINE, CHARACTERIZE, AND EXPLAIN THE DIRECTION OF CURRENT FLOW

opposite	difference	voltage	conductor	free
continuous	exist	between	drawn	body
converted	energy	produced	movement	electron
current	measured	point	period (time)	basic
unit	ampere	moving	fraction	equal
one	thousand	mili	convert	divide
micro	abbreviated			

SOURCES OF ELECTRICITY

IDENTIFY FIVE SOURCES OF ELECTRICITY

functions	input	rod	energy	realize
sources	load	emersed	produces	detected
vibrations	created	speaker	redistribute	sound
attained	combination	electrodes	destroyed	connecting
path	form	demonstration	connected	spilled
short-circuit	permanent	supplied	generate	discharged
various	heat	chemical	circuit	chemical
reaction	retrieve	reactions	secondary	light
solar	plates	applications	cell	review
thermal	conclude	mechanical	sulfuric acid	derived
output	friction	creates	undergo	reverse
system	consist	reverse	converts	obtain
nuclear	exhaust	mechanically	depletes	coupled
turbene	internal	conjunctives	torque	rotate
block diagram	multilayer	generator	enormous	hydro-electric
effect	frequency	junction	operates	panels
monitoring	measured	pictorial	symbol	view
positive	disimilar	electrolyte	hydrometer	thermocouple
negative				

RESISTANCE

LIST AND DESCRIBE THE FACTORS THAT DETERMINE RESISTANCE OF WIRE - LENGTH, SIZE, TEMPERATURE & MATERIAL

device	load	constructed	resistance	physical property
opposes	current	symbol	represent	schematic
diagram	conducts	conductance	reciprocal	unit
example	inverse	relationship	increase	decrease
conductor	solid	insulation	prevent	contact
short	hook up	illustrate	flexed	flexible
circuit	twisted	reduce	breakage	material
diameter	length	temperature	examine	affect
practical	alloys	square of	produces	directly
illustrate				

IDENTIFY THE MOST COMMONLY USED RESISTORS

resistances	substances	obtained	control	elements
opportion	metal alloys	nickel	chromium	iron
carbon	graphite	tin oxide	porcelain	variety of sizes
ceramic	attached	terminal	extended	alternate
specific	fixed	ohm	applications	requirements
filler	binder	combining	molder	proper proportion
suitable	length	deposited	conducting	internal
construction	impurities	process	cutaway view	integrated
double	physical	characteristic	cross sectional	

IDENTIFY SYMBOL FOR RESISTORS & CAPACITATORS

tolerance	ratings	thousand	schematic	shorter
designation	kilo-ohm	mega-ohm	labeled	varied
adjustable	pot	potentiometer	terminal	sliding contacts
multiturn	wiper	coiled	zigzag	increase
movable contacts				

EXPLAIN THE COLOR CODE

tolerance	rating	separate	distinct	figure
selecting	dissipate	physically	standard	color
code	represents	specified order	marked	band
reliability	multiplier	significance	indicated	accuracy
high-quality	precision	achieved	maintained	
full rated power				

CIRCUIT FUNDAMENTALS

LIST THE COMPONENT PARTS OF A SIMPLE CIRCUIT

path	complete	diagram	indicate	load
incandescent	position	electron flow	plus	battery terminal
polarity	connections	together	minus	conductor
wire	closed loop	open loop	reversed	designate
complete path	switch	encountered	source	electric energy
available	applied	perform	negative	useful functions
positive	flowing			

POWER

DEFINE AND CHARACTERIZE POWER

determine
electric energy
relation
maximum amount
power
develop
watts
function
electrons
potential
measure
producing
motion
factors
pressure
energy of motion
rate of energy
basic unit
specific amount

DETERMINE POWER GIVEN VOLTAGE AND CURRENT

forcing
watts
amperes
energy per unit
total
component
microwatt
load
equals
rating
difference
produced
formula
one thousand
determine
volts
maximum
device
particular
measure
one millionth
supplies
times
result
series
multiply
basic unit
comparison
power
current
multiplication
parallel
individual
miliwatt

DETERMINE CURRENT GIVEN VOLTAGE POWER

total
several
micro
power dissipated
result
contacts
rated wattage
internal resistance
switching arrangements
various components
power ratings
excesive load
prevent damage
source
resistance
mili
developed
rearranged
elimated
connecting
voltage
multiply
increase
calculated
equation
meter
wasted
determine
individual
decrease
relationship
designed
power ratings
calculated
equals
decimal
series circuit
parallel "
rating
turning force
electric sources

CURRENT

INFORMATION

1. Define Current

electrons	movement	through
conductor	Amperes	I
intensity	flow	current
rate	6.24×10^{18}	past
given point	second	standard
milliampere	microampere	continuous
electric charges	Coulombs	negative
positive	circuit	Andre Marie Ampere
kiloampere		

2. Characterize current in terms of direction and magnitude.

Direct current	Alternating current	intensity
AC	DC	flow
electricity	electrons	maximum
direction	decreases	zero
reverse	opposite	cycle
per second	repeated	continously
number	frequency	rate
volt	ohm	resistance
current flow	ampere	Coulomb
equals	unvarying	passed
through	solution	silver
nitrate	standard	concentration
fixed	temperature	deposits

INFORMATION

2. Characterize current in terms of direction and magnitude. (Continued)

gram	equal	point
circuit	milliampere	microampere
kiloampere	one-thousandth	one-millionth
one	steady	constant
value	alternation	sine wave
hertz	cycle per second	polarity
positive	negative	charge
speed	instantaneous	electromotive force
always	produces	magnetic
field	effect	amount
small	larger	stronger
voltage drop	heat	

3. State procedures for using an ammeter.

ammeter	placed	current
pass	through	series
component	measured	total
negative	positive	terminal
electrons	enter	leave
circuit	break	polarity
ampere meter	pointer	moves
front	calibrated scale	meter face
scale	calibrate	continuous loop
ampere	milliampere	microampere
rating	maximum	current

INFORMATION

3. State procedures for using an ammeter. (Continued,

safely	measure	indicated
highest	number	full scale
reading	sensitive	delicate
instruments	destroyed	greatly
exceeds	exercise	precautions
protect	definite	procedure
step	insure	heavy
enough	damaged	remove
power	tested	battery
powered	removing	disconnecting
disconnected	leads	electrical shock
connect	break	deflect
backwards	Galvanometer	range
fused		

4. Use an Ammeter to measure current.

(Use the same list as #3 of INFORMATION, "State procedures for using an ammeter.")

SKILLS

5. Convert amperes to milliamps and microamps.

ampere	milliampere	microampere
name	shortened	amp
metric	prefixes	denote
smaller	units	milli
one-thousandth	.001	micro
one-millionth	.000001	

6. Measure and compare current at two points of a circuit.

(Use the same list as #3 of INFORMATION, "State procedures for using an ammeter.")

7. Measure and compare in a circuit at two different voltage levels.

(Use the same list as #3 of INFORMATION, "State procedures for using an ammeter.")

INFORMATION

1. State the importance of conductors and insulators.

conductor	insulator	wire
ability	conduct	solid
stranded	silver	copper
gold	aluminum	nickel
steel	constantan	nichrome
carbon	lead	tin
fine	strands	flex
rubber	plastic	glass
baklite	mica	wood
silicon	varnish	insulation
material	cover	touching
contacting	bright	spark
arc	danger	fire
start	fuse	blow
protection	safety	manufactured
molded	prevents	person
getting	shock	burn
taped	encased	protective
tubing	wiring harness	valence
electrons	electrical	chemical
characterisitics	element	depend
action	stability	determined
number	shell	filled
stable	resist	activity

INFORMATION

1. State the importance of conductors and insulators. (Continued)

form	compounds	atoms
reluctant	give up	inert
gases	capturing	free
wandering	through	atomic
structure	substances	empty
easily	dislodged	half filled
semiconductor	silicon	germanium
resistance	high	resistivity
nonconductors	dielectric constant	dielectric strength
breakdown voltage	flow	electricity
measure	nature	behavior
placed	oppositely	charged
metal plates	seperated	maximum
electric field	applied	breakdown
destruction		

2. Name soldering tools.

soldering iron	soldering gun	flux
solder	rosin core	acid core
heat sink	anti-wicking tool	power cord
handle	soldering-iron tip	40-60 solder
60-40 solder	50-50 solder	63-37 solder
eutectic solder	acid flux	rosin flux
soldering pencil	resistance soldering tool	desoldering tool

INFORMATION

2. Name soldering tools. (Continued)

Sal Ammoniac	sponge	solder wick

3. Identify soldering procedures.

soldering iron	connection	mechanical connection
electrical connection	oxygen	oxide film
resistance	cold solder joint	tin
lead	40-60 solder	60-40 solder
50-50 solder	63-37 solder	eutectic solder
wave soldering	flux	acid flux
rosin flux	acid core	rosin core
soldering gun	soldering pencil	rosin joint
heat sink	watt	wattage
brazing	silver soldering	soft-soldering
process	uniting	clean
pieces	metal	thin layer
applied	molten	alloy
sufficient	heat	preparing
surface	oxidation	removed
grease	oil	scale
oxides	melting point	content
hardness	strength	invisibly
contaminate	union	tinning
heat transfer	penetrate	molecular depth
bond	wetting	impart
total joint	conduction	surface

INFORMATION

3. Identify soldering procedures. (Continued)

heat application	solder application	residue
visible	cotton-tipped probe	alcohol
noncorrosive	solvent	visual observation

4. State the characteristics of a good soldering.

contour	visible	bright finish
solder flow	clean	taper
minimum	amount	solder
applied	dull	runover
coarse appearance	spread	melted
joint	heated	transfer
hot	melt	conduction
blowing	cool	solidifying
sufficient	disturbing	dirty
oxidized	untinned	insufficient
flux	damage	application
timing	protection	heat-sensitive
components		

SKILLS

5. Strip and tie wire for soldered connections.

wire strippers	precision wire stripper	plastic
cloth	insulation	thermal wire stripper
conductor	expose	wire

SKILLS

5. Strip and tie wire for soldered connections. (Continued)

wire braids	shields	coaxial cable
flexible	stranded	nicked
spread	solder pot	western union splice
pigtail splice	tap splice	hook splice
adjustable	long nose pliers	side cutters
bend	90°	wrap

6. Solder wires to various terminals.

hook terminal	flat connector	solder pots
post	connector pins	anti-wicking tool
inserted	partially	filling
molten	turret terminal	prevent
wicking	stranded	wire
tinning	heat sink	stiff
break	flexing	bifurcated terminal

7. Splice wires together by soldering and crimping.

wire sizes	diameter	wire
current	crimping tool	solderless terminal lu
crimp	insulation	strip
squeeze		

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SKILLS

8. Connect ends of printed wire.

wave soldering	lead	bent
clinched	pad	printed-circuit lead
smooth	bright	plated-through hole
solder	printed-circuit board	excessive
prolonged	heat application	heat damage
copper foil	miniature components	semiconductors
laminated plastic board	contour soldering	lead clinching tool
bending	component lead	gauge
wire wrap	solderless	wire
connection	peel	heat sink
minimum	heat conduction	bottom side
component side	wiring side	drawing
desoldering tool	wicking	suction

9. Measure wire size using the American Wire Gauge.

standard	gage	measuring
round	copper	wire
American Wire Gage	AWG	Brown and Sharpe Gage
0000	four-ought	4/0
largest size	No. 50	smallest size
numbers	retrogressive	decreasing
increase	slots	circular mils
diameter	reverse side	decimal equivalents
snugly	bind	

INFORMATION

1. Define and characterize voltage.

voltage	volts	electromotive force
electrical pressure	V.	Alessandro Volta
electric cell	E.	potential
potential difference	pd	emf
voltmeter	amount	pressure
required	force	one ampere
current	through	resistance
one ohm	millivolt	one-thousandth
microvolt	one-millionth	kilovolt
one thousand	induced	potential energy
joule	coulomb	voltage drop
electrostatic field	charged	positively charged
negatively charged	attracts	electrons
repels	polarity	voltage rises

2. Identify common symbols and abbreviations.

electromotive force	emf	volts
V.	voltage	E. I. R.
potential difference	pd	

3. State Ohm's Law

resistance	ohm	R.
current	ampere	milliampere
microampere	I.	voltage
volt	millivolt	microvolt

INFORMATION

3. State Ohm's Law. (Continued)

E.	Georg Simon Ohm	direct
relationship	between	electrical pressure
flow	circuit	equals
times	divided by	reactance
impedes	impedance	alternating current
formula	multiplication	division
voltage drop	IR drop	equations
power dissipation	watt	calculate
power	directly proportional	inversely proportional
joule	joule per second	

4. Identify the parts of a voltmeter.

voltmeter	meter face	pointer
DVM	spindle	hair spring
stationary field plate	movable speed cup	rotating magnet
digital	lighted segments	range
D'Arsonval meter movement		shunt resistors

5. State the procedures for using a voltmeter.

voltmeter	parallel	leads
positive	negative	range
polarity	points	measured
circuit under test	connected	directly
not	broken	disrupted
voltage drop	voltage	voltage rise

INFORMATION

5. State the procedures for using a voltmeter. (Continued)

precautions	high voltage	damage
pegging	safety	insulated
electrical shock	ground	parallax
pointer	accurately	position
reflection	mirror	line up
components		

SKILLS

6. Measure the voltage with a voltmeter.

(use the same list as #5 of INFORMATION, "State the procedures for using a voltmeter.")

7. Determine voltage, given current and resistance.

(Use the same list as #3 of INFORMATION, "State Ohm's Law.")

8. Determine current, given voltage and resistance.

(Use the same list as #3 of INFORMATION, "State Ohm's Law.")

9. Determine resistance, given voltage and current.

(Use the same list as #3 of INFORMATION, "State Ohm's Law.")

WORD-FREQUENCY LISTING FOR
IN DESCENDING ORDER BY FREQUENCY

ITEM	FREQUENCY	ITEM	FREQUENC
.	856	EACH	41
THE	834	HAVE	41
$UA	412	HOW	40
,	377	WIRE	39
A	368	(	38
OF	326	)	38
IN	314	SWITCH	38
IS	287	WORK	37
TO	275	ELECTRICITY	36
AND	243	FLOW	36
$UI	236	USE	36
$P	177	WHAT	36
OR	127	CONNECTED	35
BE	126	:	34
CIRCUIT	125	FROM	34
CURRENT	108	1	34
$U(	107	METER	33
$U)	107	POTENTIAL	33
ARE	106	TWO	31
FIG.	93	IT3	30
YOU	91	LAMPS	30
$H(	89	SERIES	30
$H)	89	NEGATIVE	29
IT	85	SOURCE	29
RESISTANCE	84	POSITIVE	28
WILL	82	ELECTRICAL	27
THIS	79	MEASURE	27
VOLTAGE	79	MUST	27
"	76	OHM3	27
AN	76	2	27
AS	76	=	26
YOUR	75	SCALE	26
FOR	74	WHEN	26
WITH	74	WHICH	26
?	71	CHARGE	25
ON	71	CHARGED	25
BY	69	WOULD	25
POWER	62	MEASURED	24
USED	62	ELECTROSCOPE	23
AT	60	MORE	23
IF	59	NOT	23
LAMP	56	PARALLEL	23
ONE	54	PER	23
THAT	53	ROD	23
ENERGY	49	THESE	23
HAS	49	TURN	23
MAY	47	VALUE	23
CAN	43	VOLTMETER	23
ELECTRON3	43	CIRCUITS	22
VOLT3	43	SHOWN	22

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UENCY OF OCCURRENCE

EQUENCY	ITEM	FREQUENCY
41	DO	21
41	NUMBER	21
40	OTHER	21
39	POSITION	21
38	WATER	21
38	WE	21
38	1.	21
37	2.	21
36	ALSO	20
36	CALLED	20
36	NOTE	20
36	SOME	20
35	BETWEEN	19
34	CONNECT	19
34	READ	19
34	VOLT	19
33	3.	19
33	5	19
31	ANY	18
30	ATOM	18
30	NO	18
30	ONLY	18
29	THERE	18
29	THEY	18
28	UNIT	18
27	WIRES	18
27	ZERO	18
27	10	18
27	100	18
27	3	18
26	ALL	17
26	FUSE	17
26	ACROSS	16
26	ALWAYS	16
25	CHARGES	16
25	KWH	16
25	LOAD	16
24	MUCH	16
23	SHOULD	16
23	SO	16
23	THAN	16
23	4.	16
23	BEEN	15
23	DOES	15
23	EXPERIENCE	15
23	HOME	15
23	MADE	15
23	NOW	15
22	PROTONS	15
22	REQUIRED	15

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WORD-FREQUENCY LISTING FOR
IN DESCENDING ORDER BY FREQUENCY

ITEM	FREQUENCY	ITEM	FREQUENC
RESISTOR	15	THEREFORE	11
SAME	15	THREE	11
SYMBOL	15	TIMES	11
THROUGH	15	WATTS	11
X	15	ADJUST	10
5.	15	BEFORE	10
FIRST	14	BUT	10
I	14	COMPONENTS	10
PATH	14	CONDUCTOR	10
SEE	14	CONDUCTORS	10
USING	14	ELECTRIC	10
WHY	14	EQUIPMENT	10
6.	14	GLOW	10
ABOUT	13	HAND	10
ELECTRON	13	INCREASE	10
EXAMPLE	13	LIKE	10
FORCE	13	MATTER	10
RANGE	13	METERS	10
SECOND	13	SHOWS	10
STUDY	13	TEN	10
TEST	13	7.	10
THEN	13	8	9
TOTAL	13	BOTH	9
15	13	CENTS	9
DIFFERENCE	12	CLOSE	9
FOUR	12	CODE	9
L	12	CONTROL	9
OFF	12	EITHER	9
OHMMETER	12	ELECTROSTATIC	9
OUT	12	INTO	9
R	12	LETTER	9
RESISTORS	12	LOOK	9
SHORT	12	MAJOR	9
SWITCHES	12	POINT	9
UP	12	RATE	9
AMMETER	11	SUCH	9
AMPERES	11	TABLE	9
ATOMS	11	AROUND	8
COLOR	11	CASE	8
END	11	COPPER	8
EQUAL	11	COST	8
GET	11	DIVIDED	8
LARGER	11	DRAW	8
LEAVES	11	DROP	8
MANY	11	E	8
PARTS	11	FT.	8
PREFIXES	11	GIVEN	8
READS	11	KNOB	8
SIMPLE	11	LAKE	8
SUPPLY	11	LAW	8

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ENCY	ITEM	FREQUENCY
11	LIGHT	8
11	LIGHTS	8
11	LONG	8
11	MEANS	8
10	MILLIAMMETER	8
10	MOST	8
10	NEGATIVELY	8
10	OPEN	8
10	SCHEMATIC	8
10	STEPS	8
10	THEIR	8
10	VULCANITE	8
10	WATT-HOURS	8
10	WAY	8
10	AGAIN	7
10	ANOTHER	7
10	APPLIANCES	7
10	BALL	7
10	BODY	7
10	BRIGHTLY	7
10	BURN	7
9	CAPACITORS	7
9	COMPONENT	7
9	COULD	7
9	DECREASE	7
9	ELECTRONIC	7
9	ELECTRONICS	7
9	ELEMENT	7
9	EXPERIENCES	7
9	FLOWING	7
9	FLOWS	7
9	FOOT-POUNDS	7
9	FOUND	7
9	FUSES	7
9	GLASS	7
9	HAPPEN	7
9	HOT	7
8	HOUSE	7
8	LAWN	7
8	LEAD	7
8	LESS	7
8	MARKS	7
8	MATERIALS	7
8	MOVE	7
8	PART	7
8	PROJECT	7
8	RAIN	7
8	SET	7
8	STORED	7
8	TERMINAL	7

ITEM	FREQUENCY
THIRD	7
TOGETHER	7
TOUCH	7
UNDERSTAND	7
VALUES	7
WERE	7
WIRING	7
AMOUNT	6
AMPERE	6
BASIC	6
CAPACITY	6
COMPANY	6
CONCLUSIONS	6
CONSISTS	6
CONTACT	6
DEFINED	6
DEVICE	6
DOWN	6
ELEMENTS	6
EQUALS	6
FIVE	6
HEAT	6
HIGH	6
HOWEVER	6
INCREASED	6
INCREASES	6
INFINITY	6
LB.	6
LEADS	6
LEARNED	6
M	6
MARKED	6
MATERIAL	6
NUCLEUS	6
OHM	6
OUR	6
POINTER	6
READING	6
RED	6
REPEL	6
ROAD	6
SAFETY	6
TAKE	6
TERMINALS	6
THREE-WAY	6
TIME	6
TURNED	6
TYPE	6
TYPES	6
TYPICAL	6

WORD-FREQUENCY LISTING FOR THIS TEXT
IN DESCENDING ORDER BY FREQUENCY OF OCCURRENCE

ITEM	FREQUENCY	ITEM	FREQUENCY
USES	6	PLASTIC	5
VARIABLE	6	POSITIVELY	5
VOLTAGES	6	PRACTICE	5
WAS	6	PRESSURE	5
WATT	6	RECORD	5
0	6	REFER	5
10.	6	REPEAT	5
117	6	RESULTS	5
20	6	RIGHT	5
8.	6	ROTARY	5
9.	6	SEVERAL	5
-	5	SILVER	5
8	5	SINGLE	5
BALLOON	5	SINGLE-PULE	5
BALLS	5	SMALLER	5
BECOME	5	UNDERSTANDING	5
BLACK	5	UNTIL	5
BOARD	5	USUALLY	5
C	5	VERY	5
CAUSE	5	WALL	5
CHANGE	5	WHERE	5
COMMON	5	WORKING	5
CONNECTIONS	5	4	5
CURRENTS	5	500	5
DESTROY	5	6	5
DIAGRAM	5	.5	4
DIAL	5	--	4
DID	5	ABILITY	4
DIRECTION	5	ABOVE	4
DONE	5	ANSWERS	4
ELECTRICITY-ELECTRON	5	ARROWS	4
EXPERIMENTER	5	ATOMIC	4
FAMILY	5	AUDIBLE	4
FIELD	5	BAND	4
FORM	5	BANDS	4
GENEROUS	5	BECAUSE	4
GOOD	5	BOX	4
GREEDY	5	BRIGHTNESS	4
HELP	5	BRING	4
LEFT	5	BROUGHT	4
LIST	5	CANNOT	4
LONGER	5	CAPACITOR	4
MEASUREMENT	5	CARBON	4
MEASURING	5	CELLS	4
MOUNTAIN	5	CENTER	4
NEED	5	CLOTH	4
OSCILLATOR	5	CONDUCT	4
OWN	5	CONDUCTING	4
PERCENT	5	CONNECTING	4
PIECE	5	CONNECTION	4

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WORD-FREQUENCY LISTING FOR
IN DESCENDING ORDER BY FREQUENCY

ITEM	FREQUENCY	ITEM	FREQUENC
CONSIDERED	4	RELATIONSHIP	4
DANGEROUS	4	REMAIN	4
DETECTOR	4	REMOVE	4
DETERMINED	4	RESISTIVE	4
DEVICES	4	REST	4
DIVISIONS	4	RESULT	4
DROPS	4	ROOM	4
EXISTS	4	SIDE	4
EXPLAIN	4	SINCE	4
FAUCET	4	SIZE	4
FEET	4	SPECIFIED	4
FOIL	4	TERM	4
FORWARD	4	THEM	4
FREQUENTLY	4	TOO	4
FURTHER	4	TOP	4
GREATER	4	TRAFFIC	4
GREEK	4	TRANSFER	4
GROUND	4	WELL	4
HALF	4	WISH	4
HEAVY	4	WITHOUT	4
HOUR	4	WOOL	4
IDENTIFIED	4	1000	4
INCH	4	11.	4
INDICATING	4	12.	4
ION	4	150	4
JUST	4	25	4
KILOWATT-HOUR	4	50	4
KILOWATT-HOURS	4	.05	3
KNOWLEDGE	4	1	3
LEARN	4	A.	3
LIFT	4	ACTION	3
LOW	4	ADD	3
MARK	4	AFTER	3
MILLIAMPERES	4	AID	3
MINUTE	4	APPEARS	3
MOVEMENT	4	ASSUME	3
MULTIMETER	4	AVAILABLE	3
NATURE	4	AWAY	3
NEEDLE	4	B.	3
NEW	4	BATTERY	3
OPENS	4	BILL	3
OPPOSITE	4	BLOW	3
OPPOSITION	4	BREAKERS	3
ORBITS	4	C.	3
PLACED	4	CAPACITANCE	3
POINTS	4	CARRY	3
POSITIONS	4	CERTAIN	3
PROPERTY	4	COLORED	3
RANGES	4	COMPARE	3
READINGS	4	CONTINUE	3

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TEXT
OCCURRENCE

ITEM	FREQUENC	ITEM	FREQUENCY
CONTINUITY	3	LIVE	3
CONTROLLED	3	MAXIMUM	3
CORDS	3	MEASURES	3
COURSE	3	MIGHT	3
COVERED	3	MINUTES	3
D	3	MOLECULE	3
DEFINITE	3	MONTH	3
DEMONSTRATE	3	MOTOR	3
DIFFERENT	3	MULTIMETERS	3
DIGITAL	3	MULTIPLE	3
DIRECTLY	3	MULTIRANGE	3
DISCHARGE	3	NAMED	3
DISCONNECT	3	NECESSARY	3
DOUBLE-POLE	3	NEUTRAL	3
DPDT	3	NEUTRONS	3
DRY	3	NUMBERS	3
DUE	3	OBSERVE	3
ELECTRICALLY	3	ONCE	3
ENDS	3	OPERATE	3
ENGINE	3	OPPOSE	3
EXACTLY	3	ORDER	3
EXPAND	3	OVER	3
EXPERIMENTS	3	P	3
EXPRESSED	3	PARTICLES	3
FALLING	3	PASS	3
FINGER	3	PATHS	3
FINGERS	3	PROBABLY	3
FOLLOWING	3	PROBLEM	3
FOOT	3	PRODUCE	3
FORCED	3	PRODUCED	3
FREE	3	PROPER	3
GRAPH	3	PROTECT	3
HEIGHT	3	PROVE	3
HIS	3	PUSH	3
HOLD	3	QUANTITY	3
HOOKUP	3	QUICKLY	3
ILLUSTRATION	3	RADIO	3
IMPORTANT	3	REDRAWN	3
INDICATED	3	RELATED	3
INDUCTIVELY	3	REMOVED	3
INSULATED	3	REPLACE	3
INTEGRATED	3	REPRESENT	3
INVISIBLE	3	REPRESENTED	3
IRON	3	REPRESENTS	3
KEY	3	RUB	3
KITCHEN	3	RUBBER	3
LAWS	3	RULES	3
LEAVE	3	RUN	3
LINE	3	SAFE	3
LITTLE	3	SAY	3

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WORD-FREQUENCY LISTING FOR THIS TEXT
IN DESCENDING ORDER BY FREQUENCY OF OCCURRENCE

ITEM	FREQUENCY	ITEM	FREQUENCY
SECONDS	3	ALLOWS	2
SELECT	3	ALUMINUM	2
SELF-POWERED	3	AMONG	2
SERVICE	3	AMPS	2
SILK	3	ANYTHING	2
SIX	3	APPLIANCE	2
SIZES	3	APPLIED	2
SMALL	3	APPROACHES	2
SOLDERING	3	AREA	2
SPACE	3	ASK	2
STRUCTURE	3	ASSUMED	2
STUDENTS	3	ATTRACT	2
SWITCHING	3	BACK	2
TEACHER	3	BECOMES	2
TERMS	3	BEHAVE	2
THIRTY	3	BEING	2
THOSE	3	BENCH	2
TOLERANCE	3	BEST	2
TOUCHING	3	BUILD	2
TRANSFERRED	3	BUILDING	2
TRY	3	BUILT	2
TV	3	BURNS	2
UNITS	3	CABLE	2
UNLIKE	3	CAR	2
V	3	CHANGES	2
WATCH	3	CHARACTERISTICS	2
WEIGHT	3	CHART	2
WIDE	3	CHECKER	2
WORDS	3	CHEMICAL	2
WORLD	3	CLOSED	2
WRITE	3	COMPUTER	2
WRONG	3	CONDITION	2
YET	3	CONDUCTION	2
3-4	3	CONSIDER	2
30	3	CONSIST	2
.005	2	CONSUMED	2
.02	2	CONTACTS	2
.03	2	CONTAINING	2
+	2	CONVENIENCE	2
———	2	CONVERSION	2
ACCEPTABLE	2	CORRECT	2
ACCIDENTALLY	2	COSTS	2
ACCORDING	2	COULOMB	2
ACCURATE	2	COVERS	2
ACTUAL	2	CREATED	2
ADDED	2	D.	2
ADJUSTED	2	DECREASES	2
AFFECT	2	DEPENDS	2
AGE	2	DESIRED	2
ALLOW	2	DETECT	2

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WORD-FREQUENCY LISTING FOR TH
IN DESCENDING ORDER BY FREQUENCY O

ITEM	FREQUENCY	ITEM	FREQUENCY
DETERMINE	2	HAPPENS	2
DETERMINING	2	HAVING	2
DIALS	2	HEATER	2
DIP	2	HEATERS	2
DIRECT	2	HERE	2
DISCONNECTED	2	HIGHER	2
DISCOVERED	2	HIGHEST	2
DISTANCE	2	HORSE	2
DIVISION	2	HORSEPOWER	2
DOGS	2	HUNDRED	2
DOING	2	HUNDREDS	2
DOOR	2	HYDROGEN	2
DOUBLE-THROW	2	IC	2
DRAWING	2	IDEA	2
DRAWN	2	ILLUSTRATES	2
EFFECT	2	INDICATE	2
ELECTROMOTIVE	2	INDUCTANCE	2
ELECTROSTATICS	2	INDUCTOR	2
EMF	2	INFLUENCE	2
ENTRANCE	2	INFORMATION	2
ESPECIALLY	2	INSTRUMENT	2
ESTABLISHED	2	INSTRUMENTS	2
EXPENSIVE	2	INSULATION	2
EXPERIMENT	2	INSULATOR	2
EXPLANATION	2	INVERSELY	2
EXTENSION	2	IR	2
EYES	2	JAMES	2
FACT	2	JAR	2
FACTORS	2	JUMPER	2
FACTS	2	JUNCTION	2
FAILURE	2	KEPT	2
FAMILIAR	2	KILO	2
FARADS	2	KINDS	2
FEW	2	KNOW	2
FIND	2	KNOWN	2
FIRE	2	LABORATORY	2
FIXED	2	LANGUAGE	2
FOLLOWS	2	LARGE	2
FORMS	2	LEARNING	2
FORMULA	2	LENGTH	2
FOURTEEN	2	LIFE	2
FOURTH	2	LIMITS	2
FRONT	2	LIQUID	2
FUR	2	LOCATION	2
GAGE	2	LOCATIONS	2
GAS	2	LOCK	2
GENERALLY	2	LOOKING	2
GO	2	LOT	2
GRAVITY	2	LOWER	2
HAD	2	LOWEST	2

TEXT
OCCURRENCE

ITEM	FREQUENCY
MAGNETIC	2
MAJORITY	2
MAKE	2
MEANING	2
MEASUREMENTS	2
MEET	2
MEGA	2
MELTS	2
METAL	2
MILES	2
MODELS	2
MOMENT	2
MOW	2
MOWER	2
MULTIPLIED	2
NARROW	2
NEARBY	2
NEEDS	2
NEVER	2
NEXT	2
NICHROME	2
NIGHT	2
NO.	2
OBJECT	2
OCCUPIES	2
OCCUR	2
OHMMETERS	2
OMEGA	2
OTHERS	2
OUTSIDE	2
OXYGEN	2
PAPER	2
PARTICLE	2
PARTICULAR	2
PERFORMED	2
PHYSICS	2
PIPE	2
PLANT	2
POLARITY	2
POUND	2
PRESENCE	2
PREVIOUS	2
PREVIOUSLY	2
PRINTED	2
PROBE	2
PRODUCES	2
PROOF	2
PROTECTED	2
PROTECTION	2
PROTECTIVE	2

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ITEM	FREQUE
PURCHASED	
QUITE	
RATHER	
REACTANCE	
RECONNECT	
REFERRED	
REPELS	
REPLACED	
REQUIRES	
ROASTER	
RUBBED	
RUBBING	
SALT	
SAVE	
SCALES	
SCIENTIST	
SCREWDRIVER	
SENSOR	
SEPARATED	
SETS	
SETTING	
SEVERE	
SHOCKED	
SHOCKS	
SHORTED	
SHORTER	
SHORTING	
SIGN	
SILICON	
SIMILAR	
SINK	
SITUATION	
SMALLEST	
SOCKET	
SOLUTION	
SOLVING	
SOMETIMES	
SOMEWHAT	
SOUND	
SPARKS	
SPDT	
SPEAK	
SPEED	
START	
STATE	
STATES	
STEAM	
STREAM	
STRING	
STUDENT	

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WORD-FREQUENCY LISTING FOR THIS TEXT
IN DESCENDING ORDER BY FREQUENCY OF OCCURRENCE

ITEM	FREQUENCY	ITEM	FREQUENCY
STUDIED	2	5000	2
STUDIES	2	6-26	2
SUM	2	6-8	2
SURROUNDING	2	7	2
SW	2	.1	1
SYSTEM	2	$36.00	1
TAKES	2	$83.75	1
TAPE	2	*****2	1
TECHNICIAN	2	*****3	1
TELLS	2	*****4	1
TESTED	2	*****6	1
TESTER	2	/	1
TODAY	2	ABBREVIATION	1
UNKNOWN	2	ABILITIES	1
UNLIMITED	2	AC	1
VARIOUS	2	ACCIDENT	1
VIGOROUSLY	2	ACCURATELY	1
WANT	2	ACQUIRE	1
WEAK	2	ACT	1
WEEK	2	ACTING	1
WET	2	ACTIVATE	1
WHILE	2	ACTUALLY	1
WIDER	2	ADDING	1
WITHIN	2	ADVANCES	1
WOOD	2	AFFAIR	1
WORD	2	AGO	1
WORKS	2	ALARM	1
YES	2	ALESSANDRO	1
1/2	2	ALLOWED	1
13.	2	ALMOST	1
14.	2	ALONE	1
15.	2	ALREADY	1
1675	2	ALTERNATING	1
186,000	2	AMPERAGE	1
2-2	2	ANNOUNCED	1
2-7	2	ANYWHERE	1
2-9	2	APART	1
2000	2	APPEAR	1
292.5	2	APPRECIATED	1
3-1	2	APPROXIMATELY	1
3-13	2	AREAS	1
3-15	2	ARRANGEMENT	1
3-18	2	ARRANGEMENTS	1
3-23	2	ARRIVAL	1
3-9	2	ARRIVE	1
300,000,000	2	ASSEMBLED	1
3152	2	ASSOCIATED	1
4-4	2	ATTEMPT	1
4-8	2	ATTRACTED	1
4827	2	AUTOMATIC	1

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WORD-FREQUENCY LISTING FOR T
IN DESCENDING ORDER BY FREQUENCY

ITEM	FREQUENCY	ITEM	FREQUENC
AUTOMATICALLY	1	CHANCES	1
AUTOMOBILES	1	CHASSIS	1
AVAILABILITY	1	CHEAPER	1
AWARE	1	CHEST	1
AWARENESS	1	CHIPPING	1
BACKWARDS	1	CHLORINE	1
BASED	1	CHRISTMAS	1
BASICALLY	1	CIRCLES	1
BECOMING	1	CIRCUITRY	1
BEGINNERS	1	CIRCUMSTANCES	1
BEGINNING	1	CL	1
BELL	1	CLOSELY	1
BELONGING	1	CLOSES	1
BELOW	1	COAL	1
BEND	1	COIL	1
BENT	1	COMBINATION	1
BILLIONS	1	COMMERCIAL	1
BINDING	1	COMPANIES	1
BIT	1	COMPARED	1
BLOCKS	1	COMPLETE	1
BLOWN	1	COMPLETELY	1
BODIES	1	COMPOUND	1
BOILERS	1	COMPOUNDS	1
BOOK	1	COMPUTED	1
BORROW	1	CONCEPTS	1
BOTTOM	1	CONCERNED	1
BRANCH	1	CONCLUSION	1
BREAD	1	CONDUCTORS	1
BREADBOARD	1	CONDUIT	1
BREAKER	1	CONSTANT	1
BRIGHT	1	CONSTRUCTION	1
BRINGS	1	CONSTRUCTIONAL	1
BROWN	1	CONSUMPTION	1
BURNED	1	CONTAINS	1
BURNING	1	CONTINUED	1
BUSINESS	1	CONTROLLING	1
BUTTONS	1	CONVENIENT	1
CABINET	1	CONVENTIONAL	1
CABLES	1	CONVERT	1
CAPACITIVE	1	CORD	1
CAPTURE	1	CORRECTED	1
CAREFUL	1	CORRECTLY	1
CARELESSNESS	1	CRACKLING	1
CARPET	1	CREW	1
CAT	1	DAILY	1
CAUSES	1	DAMAGE	1
CEILING	1	DANGER	1
CELL	1	DAYS	1
CENTURY	1	DEAD	1
CERTAINLY	1	DECORATION	1

TEXT
OCCURRENCE

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ITEM	FREQUENCY
DECREASED	1
DEFINITION	1
DELICATE	1
DEMONSTRATED	1
DEMONSTRATES	1
DEPARTMENT	1
DEPENDING	1
DESCRIBE	1
DESIGNED	1
DESTROYED	1
DETAILS	1
DETECTS	1
DETERMINES	1
DIAL-IN-LINE	1
DIFFICULT	1
DIPSWITCH	1
DIRT	1
DISCOVER	1
DISCUSSION	1
DISPLAYED	1
DISSIPATE	1
DISTRIBUTION	1
DISTURB	1
DISTURBED	1
DIVIDES	1
DOORBELL	1
DOORS	1
DOWNWARD	1
DPST	1
DRAWINGS	1
DRAWS	1
DRIFT	1
DRIVEN	1
DRIVES	1
DROPPED	1
DUST	1
E/I	1
E/R	1
EARLIER	1
EARLY	1
EASIEST	1
EASILY	1
EASY	1
EFFECTIVE	1
EFFORT	1
EIGHT-POLE	1
EIGHTH	1
EIGHTHS	1
ELECTRICIAN	1
ELECTRICIANS	1
ELEVATION	1
ENCLOSED	1
ENGINEER	1
ENLARGED	1
ENTER	1
EQUATIONS	1
ERRANDS	1
EVEN	1
EVER	1
EVERY	1
EVERYDAY	1
EXACT	1
EXAMPLES	1
EXCEEDED	1
EXCESS	1
EXCITING	1
EXISTING	1
EXPANDED	1
EXPECT	1
EXPECTED	1
EXPERIENCED	1
EXPESS	1
EXPLORING	1
EXPRESSES	1
EXTENSIONS	1
EXTRA	1
EYESIGHT	1
FABRICATE	1
FACTOR	1
FALL	1
FALLS	1
FAR	1
FARM	1
FASHION	1
FELLOW	1
FEWER	1
FIFTY	1
FIGS.	1
FIGURE	1
FINAL	1
FLASHLIGHT	1
FLOOR	1
FLY	1
FOLLOW	1
FORESTRY	1
FORGOTTEN	1
FORMULATED	1
FOUNTAIN	1
FREEDOM	1
FRICTION	1

WORD-FREQUENCY LISTING FOR THIS TEXT
IN DESCENDING ORDER BY FREQUENCY OF OCCURRENCE

ITEM	FREQUENCY	ITEM	FREQUENCY
FRIENDLY	1	HYDROELECTRIC	1
FULL	1	H2	1
FUN	1	IDENTIFY	1
FUNDAMENTAL	1	IDENTIFYING	1
FUSING	1	ILLUSTRATED	1
FUTURE	1	IMPROPER	1
GAINED	1	INCLUDE	1
GALLONS	1	INCLUDED	1
GATHERED	1	INCLUDES	1
GENERATE	1	INCONVENIENT	1
GENERATED	1	INDEPENDENT	1
GENERATION	1	INDIVIDUAL	1
GENERATORS	1	INDUCTIVE	1
GENTLE	1	INDUSTRY	1
GETTING	1	INEXPENSIVE	1
GIFT	1	INNOCENT	1
GIVES	1	INQUIRE	1
GLOWED	1	INSIDE	1
GLOWS	1	INSPECTION	1
GOLD	1	INSTEAD	1
GONE	1	INSUFFICIENT	1
GRAIN	1	INSULATING	1
GRASS	1	INSULATORS	1
GREATEST	1	INTERESTING	1
GREEN	1	INTERNAL	1
GRINDING	1	INTERNATIONAL	1
GROW	1	INVENTED	1
GUN	1	INVENTOR	1
HAM	1	INVITING	1
HANDLE	1	IONS	1
HANDLING	1	IRONS	1
HANDS	1	ISAAC	1
HANDY	1	ITALIAN	1
HANG	1	ITSELF	1
HARD	1	JAM	1
HAZARDOUS	1	JOB	1
HEAR	1	JOBS	1
HEART	1	KEEPS	1
HEATING	1	KEYS	1
HENRYS	1	KIND	1
HIGHWAY	1	KIT	1
HITS	1	KITS	1
HOBBYISTS	1	KITTEN'S	1
HOLDING	1	KITTY	1
HOMES	1	KNOCK	1
HONOR	1	KOHMS	1
HOOKED	1	LABORATORIES	1
HOURS	1	LAST	1
HRS.	1	LATER	1
HUNG	1	LEADING	1

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WORD-FREQUENCY LISTING FOR
IN DESCENDING ORDER BY FREQUENCY

ITEM	FREQUENCY	ITEM	FREQUEN
_EAST	1	NAME	1
_ESSONS	1	NEEDED	1
_ET	1	NEIGHBORHOOD	1
_ETER	1	NEITHER	1
_ETIERS	1	NEWLY	1
_EVEL	1	NEWTON	1
_IGHTLY	1	NONCONDUCTOR	1
_IMIT	1	NONMOVING	1
_IVING	1	NOR	1
_M	1	NORMAL	1
_OCALITY	1	O	1
_OCATED	1	OBSERVED	1
_OOKED	1	OBTAIN	1
_OSING	1	OCCUPATION	1
_OSS	1	OCTOPUS	1
MAKING	1	OFFICE	1
MANNER	1	OFTEN	1
MATCH	1	OHM-METER	1
MATHEMATICS	1	OHM'S	1
MAXIMIZE	1	OIL-FUELED	1
MECHANICS	1	OLDER	1
MEGOHM	1	ONE-HALF	1
MEGOHMS	1	ONES	1
MELT	1	OPERATES	1
MEMORIZED	1	OPERATING	1
METHOD	1	OPERATOR	1
MICRO	1	OPPOSING	1
MICROAMPERES	1	OUT-OF-BALANCE	1
MICROCOMPUTER	1	OUTLET	1
MICROFARADS	1	OUTLETS	1
MICROHENRYS	1	OUTPUT	1
MICROMINIATURE	1	OUTWARD	1
MILLIHENRYS	1	OVERPROTECTIVE	1
MINIMUM	1	PACKAGE	1
MINOR	1	PANEL	1
MINUS	1	PASSED	1
MIXTURES	1	PASSING	1
MODEL	1	PAT	1
MODERN	1	PECULIAR	1
MOISTURE	1	PEN	1
MOLECULES	1	PERFORM	1
MONITORED	1	PERFORMS	1
MOUNTED	1	PERSONAL	1
MOVES	1	PHYSICAL	1
MOVING	1	PICOFARADS	1
MU	1	PICTURED	1
MULTIPLY	1	PIECES	1
MYSTERIOUSLY	1	PITH	1
MYSTERY	1	PLACE	1
NA	1	PLACES	1

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ITEM	FREQUENCY
PLANTS	1
PLATES	1
PLUG	1
PLUG-IN	1
PLUGS	1
PLUS	1
POLISHING	1
POOR	1
POPULAR	1
POPULARITY	1
POSSESSING	1
POSTIVE	1
POSTS	1
POTENTIOMETER	1
POUNDS	1
PRACTICING	1
PRECISE	1
PREFIX	1
PRESENTED	1
PREVENTED	1
PREVENTS	1
PRINCIPLES	1
PRISON	1
PROBES	1
PROBLEMS	1
PROCEED	1
PROGRAM	1
PROPERLY	1
PROPERTIES	1
PROTECTOR	1
PROTON	1
PROVED	1
PROVIDE	1
PROVIDED	1
PROVIDES	1
PROVIDING	1
PULL	1
PURE	1
PURPOSE	1
PURPOSES	1
PURR	1
PUSHING	1
PUSSYCAT	1
PUT	1
QUANTITIES	1
RADIATE	1
RAINING	1
RATED	1
RATES	1
RATING	1

ITEM	FREQUE
RC	1
REACH	1
REACTION	1
READER	1
READY	1
REALLY	1
REAR	1
REASON	1
RECEIVING	1
RECEPTACLE	1
RECEPTACLES	1
RECHARGED	1
RECONNECTED	1
REDUCE	1
REDUCED	1
REFERRING	1
REGULATED	1
RELATIONSHIPS	1
RELATIVELY	1
RELEASED	1
REMAINS	1
REMEMBER	1
REPELLED	1
REPORT	1
REPRESENTING	1
REQUIRE	1
RESET	1
RETAIN	1
RETARDING	1
RETURN	1
RETURNED	1
REVEALED	1
REWARDED	1
RID	1
RING	1
RINGS	1
RODS	1
ROLLS	1
ROTATING	1
RUNS	1
SAID	1
SATISFIED	1
SAVES	1
SCIENCE	1
SEAT	1
SECRET	1
SECTION	1
SEEING	1
SEEMS	1
SELDOM	1

WORD-FREQUENCY LISTING FOR THIS TEXT
IN DESCENDING ORDER BY FREQUENCY OF OCCURRENCE

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ITEM	FREQUENCY	ITEM	FREQUENCY
SELECTION	1	STAY	1
SELLS	1	STEP	1
SEND-RECEIVE	1	STICKS	1
SENDING	1	STILL	1
SENT	1	STONE	1
SEPARATE	1	STORE	1
SERVE	1	STORY	1
SERVICING	1	STREAMS	1
SETUP	1	STRINGS	1
SHARES	1	STUDYING	1
SHEET	1	SUBJECT	1
SHOCK	1	SUBSTANCE	1
SHOCKING	1	SUDDEN	1
SHOP	1	SUGGESTED	1
SHOPS	1	SUPPLIES	1
SHORTENED	1	SUPPOSE	1
SHORTS	1	SURE	1
SHOW	1	SURPRISING	1
SHOWING	1	SURROUNDED	1
SI	1	SUSPENDED	1
SIDE-BY-SIDE	1	SWITCHED	1
SIDES	1	SYMBOLS	1
SIGHT	1	TALK	1
SIGNAL	1	TEAR	1
SIGNIFICANT	1	TECHNICIANS	1
SIMPLIFIED	1	TECHNOLOGY	1
SIMULTANEOUSLY	1	TELEGRAPH	1
SIR	1	TELEPHONES	1
SIZED	1	TELL	1
SKETCH	1	TERMED	1
SKETCHED	1	TEXT	1
SLAM	1	TEXTS	1
SLIDE	1	THEORY	1
SLOW	1	THERMAL	1
SODIUM	1	THIN	1
SOLID	1	THINK	1
SOON	1	THIRDS	1
SOURCES	1	THOUGHT	1
SPEAKER	1	THOUSAND	1
SPEAKERS	1	THOUSANDTH	1
SPECIAL	1	THREADS	1
SPECIFIC	1	THUS	1
SPREADING	1	TIE	1
SPST	1	TIN	1
SQUARE	1	TOAST	1
STAIRCASE	1	TOASTER	1
STAND	1	TOOL	1
STANDARDS	1	TOOLS	1
STATIC	1	TOPICS	1
STATION	1	TOUCHED	1

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WORD-FREQUENCY LISTING FOR
IN DESCENDING ORDER BY FREQUENC

ITEM	FREQUENCY	ITEM	FREQUE
TOWARD	1	YOURS	
TOY	1	YOURSELF	
TRACE	1	ZONIE	
TRANSFORMERS	1	0-15	
TRANSISTOR	1	1.1	
TRAVEL	1	1.46	
TRAVELS	1	1.5	
TREATMENT	1	1,000,000	
TRIED	1	11	
TRIGGERS	1	117V	
TRIMMED	1	12	
TROUBLE	1	125	
TURBINE	1	13.5	
TURNS	1	1525	
TWELVE	1	17.1	
TWICE	1	17TH	
UNABLE	1	2.50	
UNBALANCED	1	2-1	
UNDER	1	2-3	
UNEQUAL	1	2-4	
UNINSULATED	1	2-5	
UNIVERSAL	1	2-6	
UNNUMBERED	1	2-8	
UNSUSPECTING	1	200	
UNWANTED	1	3.00	
UPON	1	3.5	
UPSIDE	1	3-10	
USEFUL	1	3-11	
USUAL	1	3-12	
VALUABLE	1	3-14	
VARIETY	1	3-16	
VERSATILE	1	3-19	
VIER	1	3-2	
VOLT-OHM-MILLIAMMETE	1	3-20	
VOLTA	1	3-21	
VOM	1	3-22	
W	1	3-24	
WARM	1	3-25	
WARNING	1	3-26	
WATT-HOUR	1	3-27	
WEAR	1	3-28	
WELL-RUN	1	3-29	
WH	1	3-3	
WHENEVER	1	3-30	
WHETHER	1	3-5	
WONDERED	1	3-5-7	
WORKED	1	3-6	
WRAP	1	3-7	
WRAPPED	1	3-8	
WRITTEN	1	30.50	

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ITEM	FREQUENCY
33,000	1
3949	1
4-1	1
4-10	1
4-2	1
4-3	1
4-5	1
4-6	1
4-7	1
4-9	1
550	1
555	1
585	1
6-1	1
6-10	1
6-11	1
6-12	1
6-13	1
6-14	1
6-15	1
6-16	1
6-17	1
6-18	1
6-19	1
6-2	1
6-20	1
6-21	1
6-22	1
6-23	1
6-24	1
6-25	1
6-27	1
6-28	1
6-29	1
6-3	1
6-30	1
6-31	1
6-32	1
6-33	1
6-4	1
6-5	1
6-6	1
6-7	1
6-9	1
75	1
8	1
9	1
900	1
	.
	.

Fit Them In

Below is a list of fifty-nine electrical terms. Read through the list to make sure that you recognize each of them. Then go to the exercise.

1. fifth & sixth terminal
2. lock nut
3. aluminum
4. lug
5. rotor
6. armored cable
7. mutual inductance
8. circuit breaker
9. thermal overload
10. general lighting
11. accumulative compound
12. voltage
13. reduced voltage
14. duct seal
15. brushing
16. coupling
17. series
18. impedance
19. individual
20. coil
21. contacts
22. end ball
23. normally open
24. stator
25. relay
26. conduit
27. core loss
28. thermal cutout
29. meter trough
30. conduit strap
31. compound
32. bearings
33. carbon brush
34. sill plate
35. wire nut
36. weather cap
37. overload
38. appliance
39. contacter
40. cord cup
41. toggle switch
42. receptacle
43. demand factor
44. pull elbow
45. copper
46. fuse stat
47. resistance
48. EMT
49. fuse
50. manual
51. automatic
52. slots
53. fuse holder
54. pressure connector
55. socket
56. shunt
57. lamp holder
58. NM sheath cable
59. laminations

On the following lines list each of the above terms under its proper category. Within each category, list the terms in alphabetical order. Place the list number beside each term. Where two words appear as one term, alphabetize according to the *first* word. Use a piece of scrap paper to help you get organized. The first one is done for you.

A. Fittings

1. brushing - 15
2. _____
3. _____
4. _____
5. _____

B. Conductors

6. _____
7. _____

C. Devices

8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____

D. Wiring Methods

18. _____
19. _____
20. _____
21. _____

E. Overcurrent Protection

22. _____
23. _____
24. _____
25. _____
26. _____

F. Generator

27. _____
28. _____
29. _____
30. _____

G. Motor

31. _____
32. _____
33. _____
34. _____
35. _____

H. Transformer

36. _____
37. _____
38. _____
39. _____
40. _____

I. Controller

41. _____
42. _____
43. _____
44. _____
45. _____
46. _____
47. _____
48. _____
49. _____

J. Pressure

50. _____

K. Branch Circuits

51. _____
52. _____
53. _____

L. Services

54. _____
55. _____
56. _____
57. _____
58. _____
59. _____

Fit Them In

Below is a list of fifty-nine electronics terms. Read through the list to make sure that you recognize each of them. Then go on to the exercise.

1. nichrome
2. peak
3. pliers
4. filament
5. neutron
6. carbon
7. germanium
8. coupling
9. vacuum
10. series
11. multi
12. multimeter
13. tetrode
14. copper
15. average
16. instantaneous
17. three
18. collector
19. short
20. cathode
21. pentode
22. muon
23. radio
24. proton
25. triode
26. fixed
27. base
28. self
29. solid
30. effective
31. single
32. electron
33. audio
34. stranded
35. step-up
36. tinned
37. reactance
38. parallel
39. diode
40. auto
41. power
42. insulating
43. aluminum
44. phase
45. screwdriver
46. mutual
47. silicon
48. variable
49. magnetic field
50. photo
51. amplifier
52. nucleus
53. current
54. instrument
55. isolating
56. two
57. distribution
58. wire-wound
59. emitter

On the following lines list each of the above electronics terms under its proper category. Within each category, list the terms in alphabetical order. Place the list number beside each term. Where two words appear as one term, alphabetize according to the *first* word. Use a piece of scrap paper to help you get organized. The first one is done for you.

Voltage

1. average - 15
2. _____
3. _____
4. _____
5. _____

B. Hand Tools

6. _____
7. _____

C. Transformers

8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____

D. Resistors

18. _____
19. _____
20. _____
21. _____

E. Inductance

22. _____
23. _____
24. _____
25. _____
26. _____

F. Phase

27. _____
28. _____
29. _____
30. _____

G. Atom

31. _____
32. _____
33. _____
34. _____
35. _____

H. Transistor

36. _____
37. _____
38. _____
39. _____
40. _____

I. Tubes

41. _____
42. _____
43. _____
44. _____
45. _____
46. _____
47. _____
48. _____
49. _____

J. Measuring Device

50. _____

K. Circuits

51. _____
52. _____
53. _____

L. Conductors

54. _____
55. _____
56. _____
57. _____
58. _____
59. _____

APPENDIX F

Language Lesson Outline

APPENDIX F

Sample Lesson Outline

Part I - Introduction

Listening Comprehension:

- Taped passages on cassette synchronized with graphics on microcomputer.
- Taped vocabulary and sentences on cassette synchronized with identification and yes/no comprehension items on microcomputer.

Visual Reinforcement:

- Reading passage (100-150 words) introducing vocabulary and grammar in context-presented on computer or worksheet.

Part II Drill and Practice

Vocabulary: Two language ability levels, each with two branching options, each branch offering at least two kinds of exercises.
Set A and Set B cover the same content in a new format.

	Set A		Set B	
Language Level 1	Fill in the blank with list of options	Matching with definition	True/False	Find word in list that does not belong
Language Level 2	Multiple choice	Fill in the blank	Matching synonyms antonyms	Putting words in categories

Grammar: Only one language level progressing in difficulty is provided.

Set A		Set B	
Multiple choice	Substitution	Modified Cloze	Create a sent. given all words but not form

** Vocabulary and Grammar exercises will have an escape key that will provide additional information or choices.

Part III Review

Reading Comprehension:

- Read passage and answer comprehension questions - yes/no; true/false; one word response.
- Read passage and identify key sentence or locate certain information.
- Do Cloze test with two levels of difficulty available by omitting every fourth or every seventh word.

APPENDIX G

Evaluators Review of Electronics VESL Prototype and Manual

VESL SOFTWARE EVALUATION

Content	*N/C	Poor		Good		Excellent
Appropriateness of language focus	(0)	1	2	3	4	5
Appropriateness of "hints and help" items	0	1	2	3	(4)	5
Accuracy of vocational content	(0)	1	2	3	4	5
Compatibility with other materials used.	(0)	1	2	3	4	5

Instructional Style	*N/C	Poor		Good		Excellent
Appropriateness of exercises	0	1	2	(3)	4	5
Appropriateness of learning sequence	0	1	2	3	(4)	(5)
Clarity of user directions	0	1	2	(3)	4	5
Degree of student involvement	0	1	2	(3)	4	5 More variety
Degree of student control	0	1	(2)	3	4	5

Physical Characteristics	*N/C	Poor		Good		Excellent
Quality of screen formatting (layout)	0	1	2	3	(4)	5
Simplicity of user input	0	1	2	(3)	4	5
Quality of graphics	0	1	2	3	(4)	5
Timing	0	1	2	3	(4)	5
Usefulness of listening passages	(0)	1	2	3	4	5
Student performance scoring	0	1	2	(3)	4	5

Not applicable/ ~~Doesn't app~~

*N/C = no comment ~~Not applic. to lesson~~

Target Users

Language level required for use	Beginning		Intermediate		Advanced
	1	2	3	4	5
User options	Individual		Small Group		Large Group
	1		2		3
Level of computer literacy required	None		Some		Extensive
	1	2	3	4	5

Overall

	Poor		Good		Excellent
Usefulness	N/A - 1	2	3	4	5
Interest of user	1	2	3	4	5
Flexibility of use	1	2	3	4	5

PLEASE COMMENT ON EACH OF THE FOLLOWING.
IF YOU NEED ADDITIONAL SPACE, USE THE BACK OF THIS PAGE.

Content (positive features, negative features, corrections)

Language differentiation level? Cloze - even YOU

Grammar items Vague - need explanation of use ~~not~~ in context

Instructional Style (positive features, negative features, corrections)

Total number of questions / section - general review of correct/incorrect

Clear Directions: Need directions to erase

Student Involvement: Variety of activities needed, some use of graphics in exercises

Student control: Must complete some exercises before "quitting"

Physical Characteristics (positive features, negative features, corrections)

Correct answers need highlighting

More graphics needed especially in student activities

Lessons are long

Totals would be helpful -

Target Users (positive features, negative features, corrections)

Language level high, especially cloze - how selected Random? Content words, redundancy? Intro & + concluding general statements would be helpful.

Overall (positive features, negative features, corrections)

Must be done in doses / ~~text~~

Supplement to text -

More variety of activities using graphics etc. needs.

Usefulness - Not sure of Context Use -

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VESL SOFTWARE EVALUATION

Content	*N/C	Poor		Good		Excellent
Appropriateness of language focus	(0)	1	2	3	4	5
Appropriateness of "hints and help" items	0	1	2	3 X	4	5
Accuracy of vocational content	~~0~~	1	2	3	4	5
Compatibility with other materials used.	~~0~~	1	2	3	4	5

Instructional Style	*N/C	Poor		Good		Excellent
Appropriateness of exercises	0	1	2	Average on all 3 X	4	5 *see comment
Appropriateness of learning sequence	0	1	2	(3)	4	5
Clarity of user directions	0	1	2	3	(4)	5
Degree of student involvement	0	1	2	3	4	(5)
Degree of student control	0	1	2	3	(4)	5

Physical Characteristics	*N/C	Poor		Good		Excellent
Quality of screen formatting (layout)	0	1	2	3	(4)	5
Simplicity of user input	0	1	2	3	(4)	5
Quality of graphics	0	1	2	3	(4)	5
Timing	0	1	2	(3)	4	5 * see comment
Usefulness of listening passages	0	1	2	3	(4)	5
Student performance scoring	0	1	2	(3)	4	5 * See Comments

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*N/C = no comment

Target Users

Language level required for use	Beginning		Intermediate		Advanced
	1	2	(3)	4	5
User options	Individual		Small Group		Large Group
	(1)		(2)		3
Level of computer literacy required	None		Some		Extensive
	1	(2)	3	4	5

Overall	Poor				Excellent
Usefulness	1	2	3	(4)	5
Interest of user	1	2	3	(4)	5
Flexibility of use	1	2	3	(4)	5

PLEASE COMMENT ON EACH OF THE FOLLOWING.
IF YOU NEED ADDITIONAL SPACE, USE THE BACK OF THIS PAGE.

Content (positive features, negative features, corrections)

Hints - excellent idea; reading passages very clear.
Particularly good exercises - Word Find, multiple choice vocabulary and grammar, true/False
Change - include more user instructions at the Introduction/Welcome; number items in exercises; list/give all options at the end of each exercise; score matching

Instructional Style (positive features, negative features, corrections)

clear, basically logical, straight-forward and fine for drill and practice.

Categorize exercise may be too hard; add synonyms as acceptable Responses for fill in the blank.

Physical Characteristics (positive features, negative features, corrections)

Graphics, format and layout are excellent, especially reading passages and menus.

multiple choice grammar - scoring incorrect.
Correction - add time to no response answer on Word Find
- make titles of exercises consistent with MENU

Target Users (positive features, negative features, corrections)

Intermediate level needed (Comments too colloquial)

Overall (positive features, negative features, correctio...)

The fact that it's CAI is motivating to students.
Very good flexibility - allows students to choose exercises.
Timing very flexible on exercises - students can take a long time to respond.

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Phase II

EVALUATION OF MANUAL

Organization:	Poor		Good		Excellent
Facility of use	1	(2)	3	4	5
Spacing	1	2	3	(4)	5

Content:	Poor		Good		Excellent
Usefulness	1	2	(3)	4	5
Accuracy of what?	1	(2)	3	4	5
Length material? instructions?	1	2	3	(4)	5

Style:	Poor		Good		Excellent
Clarity, easy to read	1	2	3	(4)	5
Appropriate for intended audience	1	2	3	(4)	5
Format appeal	1	2	3	(4)	5

Overall:	Poor		Good		Excellent
Section I	1	2	3	(4)+	5
Section II unclear	1	(2)	3	4	5
Section III	1	2	(3)	4	5
Appendices	(1)	2	3	4	5

- number pages
- put title or explanation of appendix on same page (IF LOST, difficult to match up)
- Appendix D needs supplementary examples (either in text or appendix)
- Sample - separate appendix or part of App D ? Needs supplementary explanation
- Appendix C - purpose is unclear

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Please keep the following points in mind when reviewing the manual for the CAI prototype. Please specify any section or page where revision is needed.

Organization

Do you recommend reading manual prior to using disks? If so, recommend this procedure.

Content - many typos.

Pg 6 - confusing
- procedure
- will it occur
- will it show

Would like more on instructional design of ~~CAI~~ VESL.

E.g. - difference between VESL (book form) & VESL (CAI form)

Style good

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DISK 1 D. SIEFER

VESL SOFTWARE EVALUATION

Content	*N/C	Poor		Good		Excellent
Appropriateness of language focus	0	1	2	(3)	4	5
Appropriateness of "hints and help" items	0	1	2	(3)	4	5
Accuracy of vocational content	0	1	2	3	(4) I think!	5
Compability with other materials used	0	1	2	3	4	5

(DK) Don't know

Instructional Style	*N/C	Poor		Good		Excellent
Appropriateness of learning sequence	0	1	2	3	(4)	5
Clarity of user directions	0	1	2	(3)	4	5
Degree of student involvement	0	1	2	(3)	4	5
Degree of student control	0	1	(2)	3	4	5

Physical Characteristics	*N/C	Poor		Good		Excellent
Quality of screen formatting (layout)	0	1	(2)	3	4	5
Simplicity of user input	0	1	2	(3)	4	5
Quality of graphics	0	(1)	2	3	4	5
Timing	0	1	2	3	(4)	5
Usefulness of (didn't have, for reading) listening passages	0	1	2	3	(4)	5
Student performance scoring	0	(1)	2	3	4	5

*N/C = no comment

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Rate each of the following exercises in terms of their degree of interest and appropriateness.

Activities	*N/C	Poor		Good		Excellent
Pre-test cloze	0	1	2	(3)	4	5
Reading passages	0	1	2	(3) +	(4)	5
Matching opposites	0	1	2	(3)	4	5
Matching synonyms	0	1	2	(3)	4	5
Fill in the blank (vocabulary)	0	1	2	(3)	4	5
Word find	0	1	2	(3)	4	5
Categorize	0	1	2	3	(4)	5
Multiple choice (grammar)	0	1	(2)	3	4	5
Fill in the blank (grammar)	0	1	(2)	3	4	5
True/False	0	1	2	3	(4)	5
Create a sentence	0	1	(2)	3	4	5
Post-test cloze	0	1	2	(3)	4	5

Target Users

	Beginning		Intermediate		Advanced
Language level required for use	1	2	(3)	4	5
	Individual		**Small Group**		**Large Group**
User options	(1)	2	and (3)	4	5
	None		**Some**		**Extensive**
Level of computer literacy required	1	2	(3)	4	5

Overall

	Beginning		Intermediate		Advanced
Usefulness	1	2	(3)	4	5
	Individual		**Small Group**		**Large Group**
Interest of user ?	1	2	3	4	5
	None		**Some**		**Extensive**
Flexibility of use	1	2	(3)	4	5

to create other CALL ESL?

PLEASE COMMENT ON EACH OF THE FOLLOWING.
IF YOU NEED ADDITIONAL SPACE, USE THE BACK OF THIS PAGE.

Content (positive features, negatives features, corrections)

SEE ATTACHED PAGE.

Instructional Style (positive features, negative features, corrections)

Some activities could include students labeling graphic/illustration
Good student control over pace of instruction but little control over content.

Physical Characteristics (positive features, negative features, corrections)

Could use more graphics, especially in opening. spacing - some screens too dense, cut back on amount of words/screen
lots of typos!

Target Users (positive features, negative features, corrections)

Requires students to have keyboarding skills especially in "create a sentence" exercise

Overall (positive features, negative features, corrections)

It's good but could be better.
It needs to be more fun. That's a strange comment but the program is too heavy, too tiring.

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DISK 2 G SHAW

VESL SOFTWARE EVALUATION

Content	*N/C	Poor		Good		Excellent
Appropriateness of language focus	0	1	2	3	4	5
Appropriateness of "hints and help" items	0	1	2	3	4	5
Accuracy of vocational content	0	1	2	3	4	5
Compability with other materials used ?	0	1	2	3	4	5

Instructional Style	*N/C	Poor		Good		Excellent
Appropriateness of learning sequence	0	1	2	3	4	5
Clarity of user directions	0	1	2	3	4	5
Degree of student involvement	0	1	2	3	4	5
Degree of student control	0	1	2	3	4	5

Physical Characteristics	*N/C	Poor		Good		Excellent
Quality of screen formatting (layout)	0	1	2	3	4	5
Simplicity of user input	0	1	2	3	4	5
Quality of graphics	0	1	2	3	4	5
Timing	0	1	2	3	4	5
Usefulness of listening (reading) passages ?	0	1	2	3	4	5
Student performance scoring ?	0	1	2	3	4	5

*N/C = no comment

Rate each of the following exercises in terms of their degree of interest and appropriateness.

Activities	*N/C	Poor		Good		Excellent
Pre-test cloze	0	1	2	(3)	4	5
Reading passages	0	1	2	3	(4)——	(5)
Matching opposites	0	1	2	3	(4)	5
Matching synonyms	0	1	2	3	4	5
Fill in the blank (vocabulary)	0	1	2	3	4	5
Word find	0	1	2	3	4	5
Categorize	0	1	2	3	(4)	5
Multiple choice (grammar)	0	1	2 ——	3	4	5
Fill in the blank (grammar)	0	1	(2)	3	4	5
True/False	0	1	2	3	(4)	5
Create a sentence	0	1	2	(3)	4	5
Post-test cloze	0	1	2	(3)	4	5

Target Users

	Beginning		Intermediate		Advanced
Language level required for use	1	2	(3)	4	5
	Individual		**Small Group**		**Large Group**
User options	(1)	2	(3) and	4	5
	None		**Some**		**Extensive**
Level of computer literacy required	1	(2)	3	4	5

Overall

	Beginning		Intermediate		Advanced
Usefulness	1	2	(3)	4	5
	Individual		**Small Group**		**Large Group**
Interest of user ? not clear	1	2	3	4	5
	None		**Some**		**Extensive**
Flexibility of use	1	2	(3)	(4)	5

PLEASE COMMENT ON EACH OF THE FOLLOWING.
IF YOU NEED ADDITIONAL SPACE, USE THE BACK OF THIS PAGE.

Content (positive features, negatives features, corrections)

Instructional Style (positive features, negative features, corrections)

Physical Characteristics (positive features, negative features, corrections)

Target Users (positive features, negative features, corrections)

Overall (positivie features, negative features, corrections)

Phase II

VESL SOFTWARE EVALUATION

Content	*N/C	Poor		Good		Excellent
Appropriateness of language focus	0	1	(2)	3	4	5
Appropriateness of "hints and help" items	0	1	2	3	(4)	5
Accuracy of vocational content	0	1	2	3	(4)	5
Compability with other materials used	(0)	1	2	3	4	5

Instructional Style	*N/C	Poor		Good		Excellent
Appropriateness of learning sequence	0	1	(2)	3	4	5
Clarity of user directions	0	1	2	(3)	4	5
Degree of student involvement	0	1	(2)	3	4	5
Degree of student control	0	1	(2)	3	4	5

Physical Characteristics	*N/C	Poor		Good		Excellent
Quality of screen formatting (layout)	0	1	2	3	(4)	5
Simplicity of user input	0	1	(2)	3	4	5
Quality of graphics	0	1	2	3	(4)	5
Timing	0	(1)	2	3	4	5
Usefulness of listening passages	(0)	1	2	3	4	5
Student performance scoring	0	1	2	(3)	4	5

*N/C = no comment

Rate each of the following exercises in terms of their degree of interest and appropriateness.

Activities	*N/C	Poor		Good		Excellent
Pre-test cloze	0	1	2	(3)	4	5
Reading passages	0	1	(2)	3	4	5
Matching opposites	0	(1)	2	3	4	5
Matching synonyms	0	(1)	2	3	4	5
Fill in the blank (vocabulary)	0	1	(2)	3	4	5
Word find	0	1	(2)	3	4	5
Categorize	0	1	2	3	(4)	5
Multiple choice (grammar)	0	1	(2)	3	4	5
Fill in the blank (grammar)	0	1	(2)	3	4	5
True/False	0	1	(2)	3	4	5
Create a sentence	0	1	2	3	(4)	5
Post-test cloze	0	1	2	(3)	4	5

Target Users

	Beginning		Intermediate		Advanced
Language level required for use	1	2	3	4	(5)
	Individual		**Small Group**		**Large Group**
User options	(1)	2	3	4	5
	None		**Some**		**Extensive**
Level of computer literacy required	1	(2)	3	4	5

Overall

	Beginning		Intermediate		Advanced
Usefulness	1	2	3	4	(5)
	Individual		**Small Group**		**Large Group**
Interest of user	(1)	2	3	4	5
	None		**Some**		**Extensive**
Flexibility of use	1	(2)	3	4	5

Please comment on each o' the following.

Content I would assume that the process of involving vocational instructors in the courseware development process led to appropriate content; I try not to second-guess instructors. I feel the material is quite theoretical, which may be best for this form of computer-based instruction: "the computer as teacher".

Instructional Style The best features are the hints and those feedback items which extend or embed information in a further linguistic context, encouraging language learning from redundancy. On the minus side, I have my biases, as everyone does, as to preferred learning style. I see the computer more as a group process facilitator, sort of an electronic interactive blackboard. Lessons which "teach" language are not as important to me as those which use language in an engaging context -- to use Paul Goldenberg's term, where language is the "currency" -- and those that promote live interaction between teachers and students. Where smaller groups are involved, I favor pairs, and in these situations, I prefer the computer not to "check" the answers (one letter off, and you're dead wrong), but to have the computer record student reactions, and provide an answer for comparison, allowing the student to process her own answer. Ideally, this approach would permit "word-processing" of student responses so that more interaction and student-generated writing would be encouraged; word processing is great for inducing freedom from fear of error so critical for language learning.

Physical characteristics Formatting is excellent, but response time is slow (as mentioned in the manual). Of authoring programs, PILOT is definitely the most accessible of Apple implementations, but its answer processing capabilities are limited. Another alternative is EnBASIC (Van Nostrand) or Dasher from Conduit, which include answer processing. But as I mentioned above, my preference in language learning is to encourage the student to be her own answer processor, thus encouraging self-correction skills. An implication is that at this point in time, the printer is a more valuable aid than the tape recorder as a language learning device to be used in conjunction with a computer.

Target users Definitely for the LEP student of high language skill ability including rather advanced reading skills. Writing is not a factor, except in the "make a sentence" activity, which is a good--but extended copying--exercise. If we may consider the teacher as a user then this is more of a content area reinforcer appropriate for vocational instructors than a facilitator for language learning in the VESL classroom/lab.

Overall On the positive side, virtually any work done by bilingual vocational educators must be viewed as breaking important ground. The lessons we learn in programming will break our dependence on publishers and make us more responsive to local program needs. I imagine that most valuable of all has been the process of working with vocational instructors, VESL teachers and programmers to come up with the goals for this project, which will be further enriched with all the feedback from the field from folks like myself.

Years ago an article was written about three different roles of the computer, namely those of tutor, tutee or tool. This is definitely a tutor program. I think of most computer as teacher applications as being very appropriate for content learning and theoretical learning that in[illegible]es drill and may require alternative learning paths of a rather rigid nature. Most language learning -- which as well necessitates drill -- is not of the above mentioned type. It is definitely more developmental, even in a case where language has a definite content focus, as in vocational education.

For the longest time, I felt that a tutee approach, such as LOGO, was more effective. With LOGO, a teacher -- preferably in a group setting -- teaches the computer to do things, and thus encourages a lively, focused learning context with much context-embedded language learning. However, few teachers will learn programming even to an elementary level, and even to the level of implementing an authoring program, I suspect.

Lately, I've been leaning to the use of the computer as a tool, of use to the learner and teacher to hold and manipulate information in powerful ways, but with the responsibility for the learning, teaching, correcting, isolating of key concepts, etc. definitely up to the participants. One of the most effective of the programs of this type is available from InterLearn, in the form of an interactive word processor -- the prototype for the Quill program available from Heath -- used most effectively with a printer, a program described along with others in an excellent treatment, **Computers, Education and Special Needs**, ed. Paul Goldenberg. Most of the computer-based work in Connecticut is being implemented with these types of materials. Instructors like them since they write them. Students appreciate making errors and then fixing them. While the learning is not measureable on the computer in the program, it is measurable in other ways, off the computer.

If the truth be known, the computer in all three of its "manifestations" -- tutor, tutee and tool -- has a role to play in bilingual vocational programs, and in language learning in general.

Therefore: congratulations on your ground-breaking work!

EVALUATION OF MANUAL

Organization:	Poor		Good		Excellent
Facility of use	1	(2)	3	4	5
Spacing ?	1	2	3	4	5

Content:	Poor		Good		Excellent
Usefulness	1	2	(3)	4	5
Accuracy	1	2	(3)	4	5
Length	1	2	(3)	4	5

Style:	Poor		Good		Excellent
Clarity, easy to read	1	(2)	3	4	5
Appropriate for intended audience	1	(2)	3	4	5
Format appeal	1	(2)	3	4	5

Overall:	Poor		Good		Excellent
Section I	1	(2)	3	4	5
Section II	1	2	(3)	4	5
Section III	1	(2)	3	4	5
Appendices	1	2	3	(4)	5

Manual Review

Organization The organizational setup was just fine, but too short. I would have liked more on each subject, with more examples and particularly more comments from real participants in the process, students especially, but teachers and programmers as well. Especially since a process was implemented and the materials were field-tested and revised, what was it like to develop these materials, and what was it like to use them? Perhaps this is outlined in the Final Report, but I would argue that this type of personalized information belongs in a user's manual, especially where education is involved.

Content Boy would I have loved to seen more on the courseware development process tantalizingly referred to in Section One.

The Teacher's Section is accurate, to be sure, but how much more of a feeling of really using them could have been conveyed with a few quotes from the field-testing instructors!

The weakest section was the third, which left many more questions than answers in my mind. Since teachers can embed their material in PILOT, where and how. Saying it's in the manual is an unnecessary short cut. A brief example would have helped immensely. Instructors are very interested in using developed materials, but they are also intrigued by the thought of making their own.

I really found the appendix materials on language functions fascinating and helpful synopses for teachers in BVE.

Style As suggested above, too impersonal. I think it's important to fight the computer mystique by revealing the process. Too much of CAI or CALL is like manna from heaven, when the real beauty of it is you can use what others develop and once you get the drift of it, you can get more involved in a process. This is especially key for "seed" prototypes: to definitely promote the notion that "It wasn't easy, but we did it, now you can too!"

APPENDIX H

LEP Students Assessment of Prototype

( ) shows number of participants

USER EVALUATION

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ABOUT ME:	Very Little		Some		Very Well
I can speak English ...	1	2(1)	3	4 (1)	5 (1)
I can read English ...	1	2	3(1)	4 (1)	5 (2)
I can understand my vocational classes ...	1	2	3(2)	4 (1)	5 (1)

THIS MATERIAL WAS:

Very easy to use	1(2)	2	3	4(1)	5	Very hard to use
Very interesting	1(4)	2	3	4	5(1)	Boring
Very easy to read	1(2)	2	3	4(1)	5	Very hard to read

THE ENGLISH IN THIS MATERIAL WAS:

Very difficult	1	2	3(2)	4	5(3)	Very easy

THE EXERCISES WERE:

Very easy	1(2)	2	3(1)	4(1)	5	Very hard

THE GRAPHICS (pictures) WERE:

Very helpful	1(3)	2	3(1)	4	5	Not helpful

THE INSTRUCTIONS WERE:

Very easy to understand	1(2)	2 (2)	3	4(1)	5	Hard to understand

THE HINTS AND HELP (H) INFORMATION WERE:

Very helpful	1(2)	2 (1)	3(1)	4	5 (1)	Not helpful

DID THIS MATERIAL HELP YOU LEARN VOCABULARY? Yes (3) No ____

If yes:	A lot					Nothing
		1(2)	2	3(2)	4(1)	5

DID THIS MATERIAL HELP YOU LEARN ABOUT RANDOM DRIFT? Yes (4) No ____

If yes:	A lot					Nothing
		1(1)	2 (2)	3(1)	4(1)	5

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WHAT DID YOU LIKE THE BEST?:

"Work with the Apple computer."
"I liked best vocabulary lesson."
"The movement of electrons, the matter and random drift."

WHAT WOULD YOU CHANGE OR ELIMINATE?:

"Nothing."
"I would like change the process of random drift."

GENERAL COMMENTS:

"The English on these lessons was very clear and understanding and I liked it very much."
"The electronics wonderful because we know the matter from all the things, the movement of electrons, the electronics communications (wireless) example AM and FM radio, broadcast (TV) etc., etc."

Thank you!

APPENDIX I

Material Resources and Human Resources

Material Resources

The Vocational ESL Handbook, by Joan Friedenberg and Curtis Bradley

The Basic Book of Electricity and Electronics, by Gerald E. Williams

Shoptalk: Vocational Reading Skills, Electricity - Electronics, by Buron J. Alpers and Mitchel L. Afrow

Apple Pilot

Human Resources

Name: Dennis Terdy
Title: Director
Illinois ESL Adult Education Service Center
Arlington Heights, IL
Contribution: Evaluation of software program

Name: Walter Secada
Title: Evaluator-Trainer
Midwest Bilingual Education Multifunctional Support Center
Arlington Heights, IL
Contribution: Assistance in program design

Name: Jose A. Rosales
Title: College Electrical Instructor
Alamo Community College
San Antonio, TX
Contribution: Validated learning objectives

Name: Thomas J. Klimiate
Title: Instructor
Hubert Humphrey Occupational Resource Center
Boston, MA
Contribution: Validated learning objectives

APPENDIX J

Product Abstract

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Illinois State Board of Education

Department of Adult, Vocational and Technical Education
Research and Development Section

Product Abstract

1. Title of material: Basic Electronics/Electricity VESL: A CAI Prototype

2. Date material was completed: September, 1984

3. Please check one: New material X Revised material ____ Field-tested material ____

4. Originating agency: Bilingual Vocational Education Project, Northwest Educational Coop.

   Address: 500 S. Dwyer, Arlington Hts., IL Zip Code: 60005

5. Name(s) of developer(s): Jeanne Lopez-Valadez, Project Coordinator

   Address: 500 S. Dwyer, Arlington Hts., IL Zip Code: 60005

6. Developed pursuant to Contract Number: R-31-14-C-0332-502

7. Subject Matter (Check only one according to Department of Education Code):

   Code

   ____ 01 Agricultural Education
   ____ 03 Business and Office Education
   ____ 04 Distributive Education
   ____ 07 Health Occupations Education
   ____ 09 Home Economics Education
   ____ 10 Industrial Arts Education
   X 16 Technical Education
   ____ 17 Trade and Industrial Education
   ____ 22 Cooperative Education
   ____ Career Education
   X Other (Specify): VESL

8. Education Level:

   ____ Pre-K Thru 6 ____ 7-8 ____ 9-10 X 11-12
   X Post-Secondary ____ Adult ____ Teacher (Pre-service)
   ____ Administrator (Pre-Service) X Other (Specify): Curriculum Development

9. Intended for Use By:

   X Student X Classroom Teacher ____ Local Administrator
   ____ Teacher Educator ____ Guidance Staff ____ State Personnel
   X Other (Specify): Curriculum Developers and computer programmers

10. Student Type:

    ____ Regular X Disadvantaged ____ Handicapped
    X Limited-English Proficiency ____ Other (Specify)

11. Medium and Format of Materials:

HARDCOPY	VIDEOTAPE	FILM	MICROFICHE
No. of pages ____	____ Minutes	____ Minutes	___ B & W
___ Paper bound	___ B & W	___ B & W	___ Color
___ Hard bound	___ Color	___ Color	
X Loose-leaf	____ inches	____ mm	
Photos: Yes ____ No ____			
Diagrams: Yes ____ No ____			

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___ Color
___ Audio

___ Automatic synch
___ ____ Hz
___ Manual cue
___ Reel
X Cassette
___ Cartridge

Specify: Computer Software
2 Disks

12. Availability

___ One copy free
___ In ERIC system (No. ____)
For sale @ $ ____ per copy
___ Not available
___ Loan copy available

Contact: Name Jeanne Lopez-Valadez Phone (312 870-4150

Address 500 S. Dwyer, Arlington Hts., IL Zip Code 60005

13. Copyright Restrictions:

Contact: Name Peter Seidman, DAVTE Phone (217 782-4620

Address 100 N. First St., Springfield, IL Zip Code 62777

14. What level(s) of assistance is required to provide implementation of this outcome?

X awareness ____ understanding
____ deciding ____ implementing

15. Are Consultive/Inservice (or staff development) available? Yes____ No____

Contact: Illinois State Board of Education
Department of Adult, Vocational and Technical Education
Research and Development Section, E-426
100 North First Street
Springfield, IL 62777
(217) 782-4620

16. General Description (State the general objective and suggested method of use. Summarize the content and tell how it is organized. Write the description so that it can be used to promote the material. Continue on back of this sheet or on another sheet, if necessary) See Below

17. Person Completing this Abstract Jeanne Lopez-Valadez

Full Address

Bilingual Vocational Education Project
Northwest Educational Cooperative
500 S. Dwyer, Arlington Hts., IL Zip 60005

16. This software package is a prototype CAI lesson for teaching vocational English related to basic Electronics/electricity to LEP students. It was designed using Apple Pilot and is adaptable to other content areas. The manual contains information regarding the process, teacher's instructions and suggestions for creating other CAI lessons for vocational ESL.